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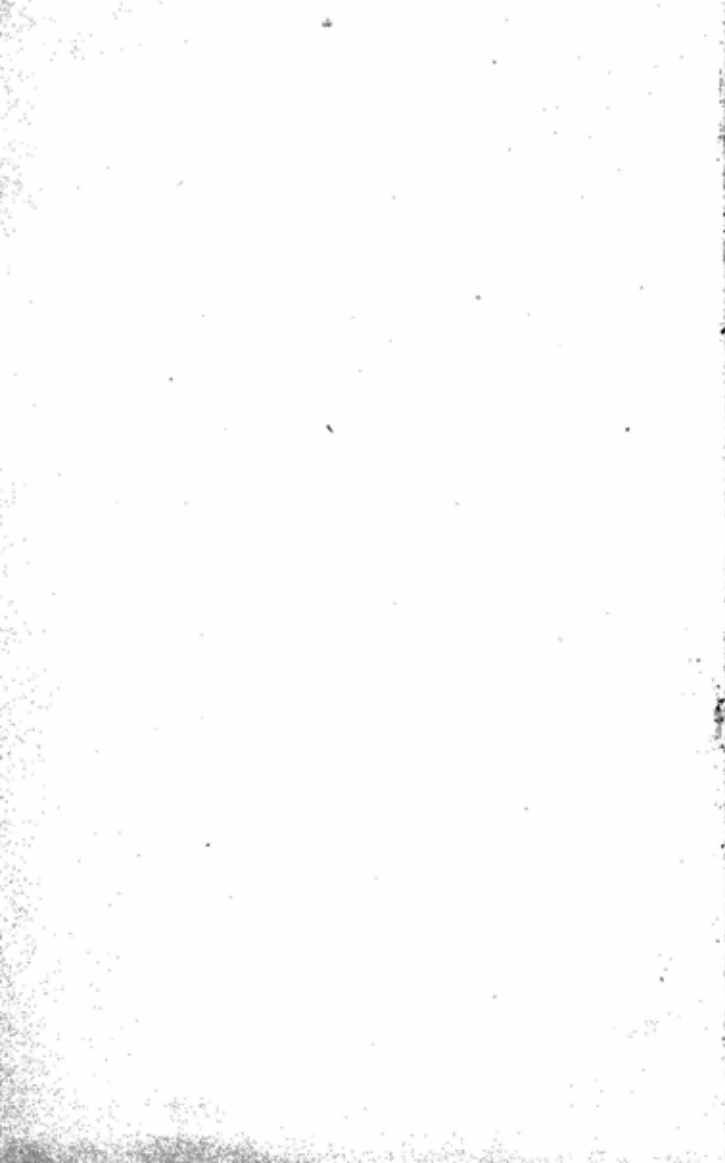
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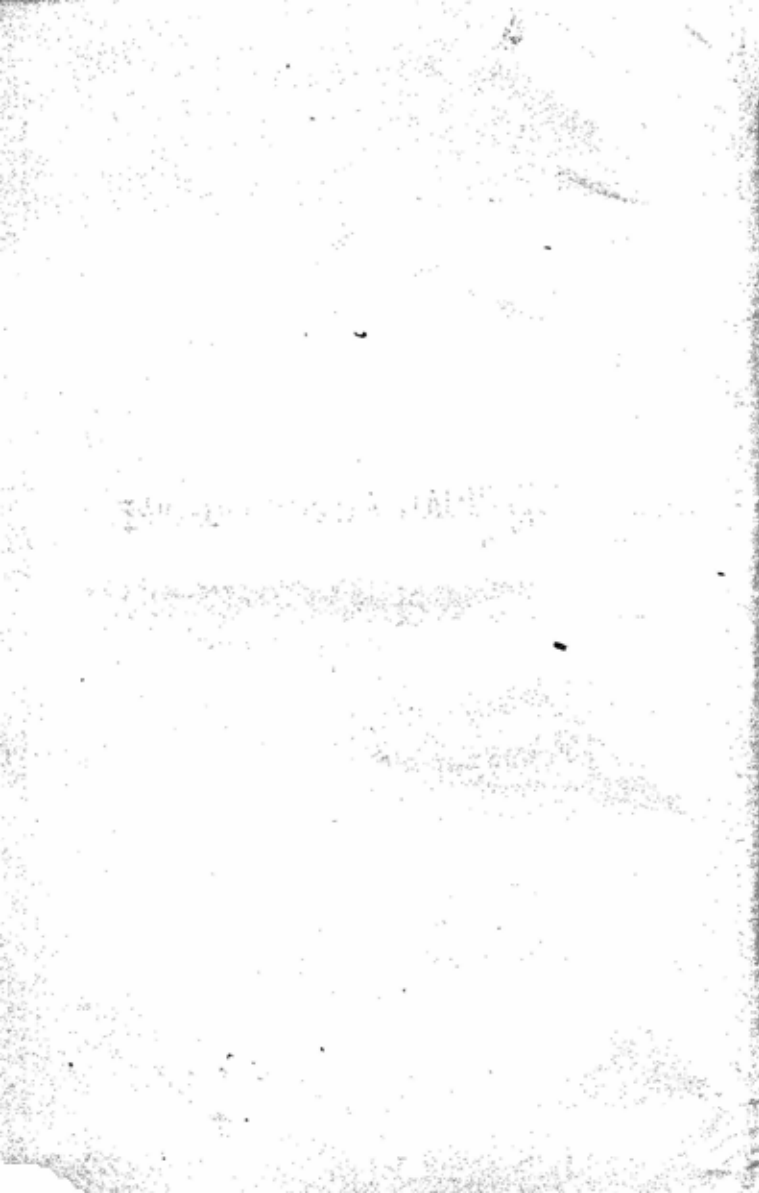
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# PHYSICAL ANTHROPOLOGY



# FUNDAMENTALS OF PHYSICAL ANTHROPOLOGY

WITH PRACTICAL METHODS & ILLUSTRATIONS

42532

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THE POST-GRADUATE BOOK MART  
55, MAHATMA GANDHI ROAD  
CALCUTTA-9 (INDIA)

Published by :

G. R. Bhattacharyya, C/o. The Post-Graduate Book Mart  
55, Mahatma Gandhi Road, Calcutta-9. (INDIA)

252.4

FIRST EDITION :

REPUBLIC DAY, 1965

CENTRAL ARCHAEOLOGICAL  
LIBRARY, NEW DELHI.

Acc. No. 42532

Date... 18.5.1965

Call No. 573.2 / Sar

Printed by :

Gour Chandra Bhukta, Mahabani Press  
156, Tarak Pramanick Road, Calcutta-6

Received from Mrs. Indian Book Service, New Delhi. 4 B. V. 6. 1878 - m.

## FOREWORD

Anthropology has been made a subject of study in the graduate and post graduate courses of the Calcutta University for a pretty long time. But no adequate text books either by Indian authors or foreign, covering the syllabus requirements there of has ever been written. Foreign books that were available in the past and prescribed by our University have long ceased to be easily available in the market. Those that are sometimes available are of whimsical prices as charged by the booksellers. All these had put our students to a lot of trouble and anxiety in acquiring adequate knowledge in it and passing their examinations in the subject.

It is a happy sign that attempts are now-a-days being made by some of the passed hands of this University to solve this anomalous situation by writing a few such hand-books covering the syllabi as far as possible. These attempts are, in my opinion, made in response to the same difficulties experienced by them in their student career in this subject. As a necessary consequence therefore they have tried with all sincerity and precision to meet the demands of our students in facing their examinations with a sound knowledge of their course of studies in the subject. The present treatise is also such a one on which our students can thoroughly depend for a first hand knowledge thereof that would help them not only to pass in the subject but to get some permanent impression of the subject matter in their minds for further reference. Prof. R. M. Sarkar has undertaken great pains to make it as comprehensive as possible and at the sametime within a short compass so as to be used as a hand book dealing with all necessary points required for examinations on the subject. . . .

I am fully and unhesitatingly recommend this book to the students of our University specially in their graduate course of studies in the subject, both in pass and honours, and am sure that it will give them the required satisfaction they have been looking for in it in past years.

*Department of Anthropology,*

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Satkari Mitra

26th. January, 1965.

## INTRODUCTION

Anthropology is becoming popular, day by day, as we find from the fact, that in India, there are at least a dozen of Universities teaching this subject, both in under-graduate and post graduate stages. This is mainly due to the fact that it has been realised now, that detailed study of this subject, unveils the past and is necessary for proper study of man, in varied situations of his physical existence. Besides, this has now exploded many age-old conjectural and pet theories regarding man's ancestry and cultural developments. Origin of life in this world, and its manifestation in vegetation and animal kingdom, is undoubtedly amazingly wonderful. But the wonder of wonders is the mankind itself. From the very origin man has witnessed thousands of natural phenomena, both hostile and beneficial; and through endless struggles and endeavours, for ages, he has been able to adjust himself with the changing situations, which made him capable to survive.

From the remotest past, up till now, scholars, both elderly and young, attempted their best to study man, his origin, his cultural developments and diversities, which, in many cases, had created problems, complications, tensions and unisons. Racial differentiation, vanity of cultural superiority, etc. had caused many a bloody conflict and encounter, while, in many cases, man's humanistic approach had fostered good relations and brought in progress and achievement. Proper and exact analysis of these factors, that is, a thorough and systematic anthropological study can dispel the surmises and uncertainties of the past, about the natural development of mankind.

My student, Sri R. M. Sarkar of the Dept. of Anthro-



logy of Bangabasi College, Calcutta, has attempted, in this treatise, to present in a simple manner, the manifold aspects of physical anthropology, like its aim, comparative anatomy of fossil remains, various ethnological concepts, classification and distribution of human races, etc. It is true that man should be studied in his biological make-up, and his culture may be conceived and evolved on the basis, how far these has enabled man to fulfil his basic biological needs. During the course of description, he has discussed not only old and new theories, but also his personal opinion, consolidated by current discoveries and findings. Besides, he has included, in this volume, a practical approach of physical anthropology including somatometry, craniometry and osteometry. The students of Indian Universities had so long no systematic or comprehensive text book on Physical Anthropology and I feel happy that Sri Sarkar's attempt in this respect, would fulfil, to a large extent, this long-felt need of the student community.

Department of Anthropology,  
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26. 1. 65.

P. K. Bhowmick

## PREFACE

Anthropology, the science of man, is regarded as an important branch of study as it satisfies all the curiosities regarding the development of man—a paragon of animals. The study and analysis of the different aspects of the origin and development of our own type are packed up with mysterious happenings. The knowledge as regards life-process and behaviour of man is essential in understanding the internal feature of any problem of man and his society. The importance of anthropology, therefore, as a subject has now been recognized in our country though it is not in the stage of fullest development. The fruits of anthropological researches are now being utilized in various Governmental and non-Governmental organizations to solve the varied problems relating to human society. In the periods of planning and national integration in India the direct help of the anthropologists are being taken for the proper implementation of the different programmes related to human welfare. On the whole, the demand for anthropological studies is increasing day by day. Naturally, the students are being attracted to this branch of science which ultimately results in the opening of teaching and researching scopes in the subject mentioned in good many Universities in India.

Under the present circumstances, there is a crying need for some thoroughly instructive and systematic text books which should deal with the problem of coming of man and his establishment on this earth as a supreme being. As a teacher of the subject I have keenly felt the difficulties of the beginners and the result of which is the present book. In this volume I have tried to present a clearer idea on the the origin, development and differentiation of man as a biological organism to the students, curious readers and the educated laymen. In this connection, I should say that I do not present any new idea or contribute any original thinking regarding the science of mankind but I have done much in giving some newness in the presentation of the subject-

matter. From the very beginning I have taken every possible step to make it informative, systematic and up to date. In this regard the present volume differs admittedly from other text books.

The book has been divided into five parts. In the first part an overall idea has been put forward as regards the nature and scope of physical anthropology with modern trends. The applied aspects of physical anthropology has also been discussed here. The second part is mainly devoted to the various discussion regarding the origin and development of man and his inter-relationship with the near relatives. Part three is engaged in telling the story of the fossilized remains of man, apes and monkeys that have been discovered from the various layers of the earth. The discussion on fossil pre hominians and hominians will give a systematic idea in understanding the nature of human evolution. Next comes part five which is devoted to the ethnological studies—the most problematic branch in physical anthropology. The term race has been and is being understood and utilized by the various persons in different ways. The misconception in the study of race is the ultimate result of race prejudice and other stereotyped ideas which have created many acute tensions in the socio-political history of mankind. The proper conception of the races of mankind is of great political and scientific importance today. To the modern raciologists the race is purely a genetic concept and, at present, they have changed their angle of vision in looking at race and its nature. In this book, I also have tried to present the readers a clearer idea of races of mankind on a genetical background. It is for this reason the ethnological studies of this book, start with a chapter on Heredity and Genetics. In this chapter I have tried to help the reader understand the nature of heredity and its mechanisms on the different spheres of life. The importance of environment in shaping the form and function of an individual organism

has also been taken into consideration in this regard. The discussion on serology and race will throw more light in understanding the race in a purely genetical background and it will tell how a genetic criteria, like blood group, can be harnessed in the classification of the races of mankind.

The racial reconstruction in India presents another complex problem. The ethnic elements of this sub-continent have been viewed and classified by many scientists in different ways. Here I have tried to review with criticism the different classifications of the races of India made by various authorities at different times. In this connection, the discussion on the ethnic features of certain primitive and semi-primitive communities of India and abroad have presented certain newness in the matter. I do not claim in presenting a thorough idea on the problem of origin and development of the races of India. Much scientific works on this problem are still to be done in gaining a thorough knowledge on the subject of the races of this sub-continent.

The part five deserves uniqueness in nature. The discussion on anthropometry and its various branches, rarely found in any other text book, have been made in a systematic way so that a beginner of the subject may find ample opportunities in getting a thorough knowledge regarding the various measurements and observations on the bodily parts of man. On the whole, the 'Fundamentals of Physical Anthropology' will offer a thorough and systematic idea in understanding man as a physical being to the different classes of people. Here I must confess that in writing the present book I have freely utilized the thoughts and ideas of many scholars and have taken the help of many standard books dealing with the different aspects of man. To all of them I delightfully acknowledge my gratitude.

I consider my prime duty to acknowledge with thanks the help and co-operation extended by my teacher, Dr. P. K. Bhowmick of the Dept. of Anthropology, Calcutta University, at the time of writing and publishing the

manuscript. Here I should point out that this book is the result of his constant inspiration and encouragement. I owe a deep debt of gratitude to him.

I am deeply indebted to my teacher Prof. S. K. Mitra, Head of the Dept. of Anthropology, Bangabasi College, for his constant encouragement in writing a systematic text book on physical anthropology. I take this opportunity to express my gratitude to him. To Dr. (Mrs.) Papiya Banerjee of the Dept. of Anthropology, Calcutta University, I am grateful for her valuable suggestions in the arrangement of chapters and other matters in the first and second part of this book. I am further indebted to my teachers and colleagues in the Dept. of Biological Sciences, Bangabasi College for their sympathy and co-operation regarding the publication of the book of this kind.

My special thanks are also due to Sri Hrishikesh Mukherjee of Uttarpada who has gone through the manuscripts. In this connection, I should like to thank all my students whose stimulation and constant pressure for a systematic text book have done much in the way of rapid publication of the present volume. Sri Gopi Ranjan Bhattacharya of M/s Post Graduate Book Mart, Calcutta, has put me into special gratitude as he has taken much troubles in getting the manuscripts printed. I also owe thanks to Sri Anil Chandra Roychowdhury who has drawn most of the sketches in a considerable short period and thereby helped me in the quick execution of the book.

I am quite aware of the shortcomings. I am also responsible for all kinds of errors and omissions that have taken place in these pages in spite of my sincerest efforts to eliminate these. All kinds of suggestions from the readers for the purpose of further improvement of the book are cordially invited.

26th January, 1965  
28/1/1, Pitambar Ghatak Lane  
Calcutta-27

R. M. Sarkar

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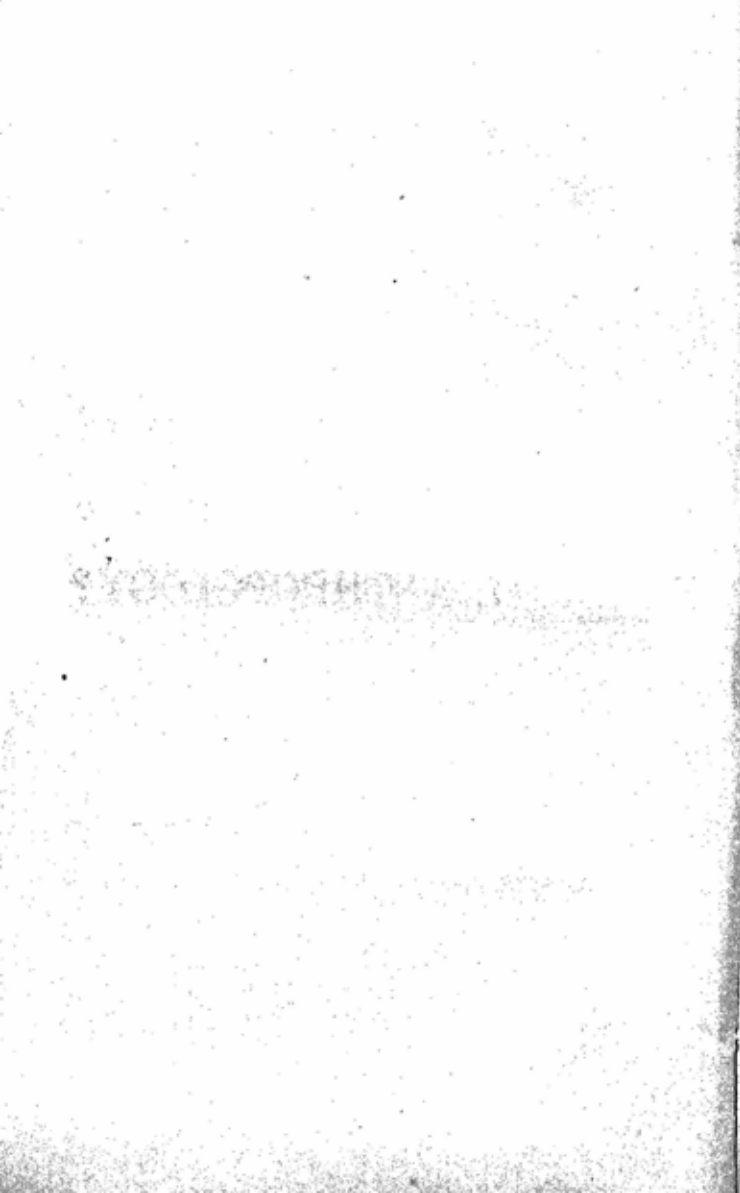
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PART ONE

WHAT IS  
PHYSICAL ANTHROPOLOGY?



## THE NATURE AND SCOPE OF PHYSICAL ANTHROPOLOGY

The term Anthropology has been derived from two Greek words, *Anthropos* and *logos*. The meaning of the former is man and the latter, science. Therefore, anthropology is the science of man. But its scope differs from that of the other sciences of man. Anthropology studies the different aspects of the life of man right from the date of his origin upto the present day. It, therefore, embraces a vast field. Anthropology can be called as the whole study of man as it views him from different angles, e.g. physical features, differences, cultural variations, social, political, religious, and other affairs. Herakovits has rightly remarked that Anthropology is the study of man and his works.

Anthropology has two separate branches—(1) Physical, and (2) Cultural. The former branch deals with the physical aspects of man—his evolution, structural variations, racial compositions, etc. During study the physical anthropologists take into considerations the facts, like the skin-colour of man in different countries, the character of hair, size and shape of nose, stature, etc., and then try to classify the people of the world in different groups based on the similarities of physical characteristics. In doing this, they also collect the bones of ancient men from the different layers of the earth and try to give a comparative analysis between these and modern men.



On the other hand, the subject matter of cultural anthropology is the life-activities of man. The cultural anthropologists study man as a cultural being. The different works, behaviour, and social patterns of man are the main-points of study of this branch of science. In studying this, a cultural anthropologist collects the various social and cultural activities of man from the different societies of the world and analyses these comparatively. He also gathers the facts from the prehistoric period which helps him in studying the development of culture through the ages. On the whole, we see that the centre of focus of anthropological studies is the Man—a unique creation of the nature.

Man's first appearance on the earth is a wonderful happening. The creation of the earth itself is also a mystery. It so happened that the sun, in its courses, came nearer to a star many times larger than the former owing to some natural reasons. As a result of the greater planetary attraction certain gaseous substances came out of the body of the sun. In the meantime, the said larger star went far away from the sun. The gaseous substances that came out of the sun began to lengthen and cool down. After sometime it gave rise to nine rounded bodies—the planets. The earth is a planet of this kind. Gradually the earth cooled down by radiation, and then it experienced a continuous heavy shower which created the ocean, the seas, the rivers and the channels on its surface. After a long time, when the conditions became favourable, life appeared on the earth. At our present state of knowledge regarding the earth and life, we cannot explain the exact process of the beginning of life. But from the geological and palaeontological evidences, we can easily say that the first life on the earth was a unicellular organism e.g. amoeba. Day by day, the unicellular simple organism attained complex forms by gradual changes in structure and ultimately gave rise to the most complex type of animal—the man. But it took much longer period and had to pass through the complicated ways. The process by which the simple and homogenous organisms gradually

became complex and heterogenous, is known as the organic evolution.

In order to have a general idea about the evolution of various forms of life, we should come to the geologists and the palaeontologists. The geologists and the palaeontologists are really helpful in obtaining the past history of man, as recorded by the different strata of the earth and the characteristic fossilized remains found in these. The different layers of the earth have been arranged chronologically with their characteristic fossil remains of plants and animals. The earliest layers contain no traces of life, and, this is why, they are known as *Azoic* or lifeless layer. Some prefer to call these as *Archaeozoic* on the ground that the first form of life was too minute and soft to leave any trace of their existence on the layers of the earth. The different layers with their characteristic fossils can be arranged like the following :—

Cainozoic	{ Quaternary (Age of Man)
(Recent life)	{ Tertiary (Age of Mammals)
Mesozoic	—Secondary (Age of Reptiles)
(Middle life)	
Palaeozoic	—Primary (Age of Fishes and Amphibians)
(Ancient life)	
Protozoic	—Evolution of different invertebrates.
Archaeozoic	—No definite traces of life.

The Quaternary epoch of the Cainozoic era is remarkable by the emergence and development of man, who is the subject matter of our study. Formerly man was regarded as the special creation of God, and it was thought that he had no relation with other animals. But at the beginning of the 19th Century the development of a few branches of science, e.g. Zoology, Palaeontology, Comparative Anatomy, Geology, etc., helped a few energetic persons to come forward demanding man's closer relationship with other animals, and thereby they tried to remove man from the domain of legends and miraculous stories. As early as the 18th Century and earlier,

bone remains of various extinct animals and 'dressed' flints had been discovered by a few scientists. On those facts, they tried to establish the great antiquity of man. The declaration of the scientists, no doubt, caused a great controversy. But when Boucher de Perthes, a French Custom Official, discovered, in the year 1846, a few dressed stone artefacts from the ancient gravels of Somme near Abbeville, the controversy regarding the antiquity of man spread throughout the length and breadth of the country. Most of the scientists of those days opposed vehemently Boucher de Perthes's claim regarding the antiquity of man. In 1854, Dr. Rigollot of Amiens after discovering a few Abbevillian type of artefacts from the sand-pits at St. Acheul strongly supported Boucher de Perthes. Then, in the year 1859, a group of distinguished British scientists examined the facts critically on the site and acknowledged the claim of Boucher de Perthes. The year 1859 will be remarkable for ever in the history of human being due to the publication of an epoch-making book 'The Origin of Species' by Charles Darwin. From the results of his painstaking researches, Darwin established the doctrine of evolution. According to him, man is a result of evolution from lower animals. Then, in the year 1871, he wrote 'The Descent of Man', in which he came to the conclusion that 'a member of the anthropomorphous sub-group gave birth to man'. The results of Darwin's researches were whole-heartedly supported by Huxley in England and Haeckel in Germany. The views of these eminent scientists brought a revolution in the line of thinking of those days regarding the origin of man. The discovery of certain fossils such as Neanderthal Man in 1856, Pithecanthropus in 1891, and Australopithecus in 1925 gave much evidences in favour of the evolutionary significance. Man did not acquire his present characters suddenly but through a longer process of evolution. That is why, the earlier types of man exhibit many differences compared to the modern man. During the Quaternary period numerous modifications took place in the human phylum, which developed in various lines, one of which

gave rise to man. The emergence of man from the non-human stock by a process of evolution has been approved by all concerned. The outstanding feature of the early Quaternary, i.e. Pleistocene is the Great Ice Age. Due to certain geographical reason the climate of the earth suddenly began to change and became colder and colder until all the water transformed into ice. According to the eminent glacialists of Europe, Penck and Brucknes, the Alps witnessed four major glacial periods, which they named after the four Alpine rivers, Gunz, Mindel, Riss, and Wurm. Between these glacial periods, there were inter-glacial periods of warmth. These climatic changes were also accompanied by great periods of mountain building. All these factors jointly did much in washing out the old forms of life and evolving into new and better types.

Our present state of knowledge is still unable to tell with certainty the exact place of human origin. The claim of South Central Asia is no doubt greater than any other places regarding the cradle of mankind. The sudden upheaval of the Himalayas during the Middle and upper Miocene brought about a change in the flora and fauna of that area. The tropical forest of the Northern side of the newly formed Himalayas gradually disappeared, which favoured the evolution of ground-dwelling type of ape. The specialisation of man occurred in the Northern region. But the claim of Africa regarding the origin of man had been established by Darwin who said that 'it is somewhat more probable that our early progenitors lived in the African continent than elsewhere.' However, the process of evolution, it may be true, was not restricted to a single continent.

From the above discussion it is seen that the subject-matter of physical anthropology is really vast and complex. But, at the same time, it is interesting for all concerned, as it tells the story of man—a unique and unparallel creation of the Nature—from the date of his origin upto the present day. A major problem of physical anthropology, then, is the early types of man and his nearest relatives among the apes and monkeys.

The study of the physical features, blood types and behaviour pattern of these apes and monkeys is necessary to understand the development of these factors in man. The physical anthropologist also tries to trace a particular structural feature from the earliest population. While searching out the nature of trait he should try to know its first appearance in man and how it became widespread and, if disappeared, the reason behind it.

After studying the origin, development, and place of evolution of man, a physical anthropologist should focus his attention towards the different varieties of man present on the various parts of the earth. All the living varieties of modern man belong to the species—*Homo sapiens*. The men of today, though differ in certain cases outwardly, are all quite similar to one another in basic characteristics. It is seen that the men found in the prehistoric beds differ greatly from the modern ones. If anybody go to the very earlier beds he will find no human forms. This fact has already been pointed out in the previous lines. Owing to this reason it has been remarked that *Homo sapiens* of today have emerged from earlier non-human forms. The way by which man developed from his non-human ancestors and also the process of change that are still going on in his bodily parts is the subject-matter of a part of physical anthropology. It is generally seen that one group of people exhibits certain common hereditary features, which differ in various ways from the other groups. The *Homo sapiens* of the world can be divided into a number of such groups known as the *Race*. The race itself is a problem and its study requires much knowledge and care. In physical anthropology the scientific study of the different aspects of race—its origin, types, migration, inter-mixture, racial physiology and psychology is a complicated, interesting, and thought-provoking matter.

The study of man will be incomplete if anybody neglects the importance of environment on man's various workings. In studying physical anthropology we should know how the

environment has affected and continues to affect the structural features of man. In studying the diversity of human forms, a physical anthropologist gives much stress on the environmental factors. The various physical features, which are the criteria for racial classification, are dependant on the environmental conditions. These are the main lines of study of the physical anthropologists.

But the focus of attention of the physical anthropologists of today is being changed. In the former days the physical anthropology has been considered primarily as a technique. The primary object of them was to measure certain external forms by means of instruments and to observe and compare these among the various groups of people. The old physical anthropology was nothing but a technique. But under the influence of modern genetic theory, the field of study has witnessed a thorough change in comparison to that of the nineteenth century. At present, the physical anthropologists are trying to put much stress on the genetic composition of a population, mechanisms of heredity, the ways in which the modifications of heredity take place etc. Owing to the impact of genetics on physical anthropology an overall change has taken place in this particular field of study.

The criteria for racial discrimination, that we are still using, are nothing but superficial characters. In recent time the attention of the physical anthropologists has been diverted and they look at the less obvious but intrinsically more important differences such as blood types, difference in musculature, etc. Also they have started to study the group differences in time of sexual maturation, in growth rates and various disease immunities. Naturally, these factors are more reliable because of the facts that these are based on genotypical features. Also these have got some practical importance and the results may be used in various ways. On the other hand, the factors like head length, nose form, etc., have little importance in the general welfare of human being. On con-

sidering all these the outlook of the physical anthropologists of today has been changed to some extent.

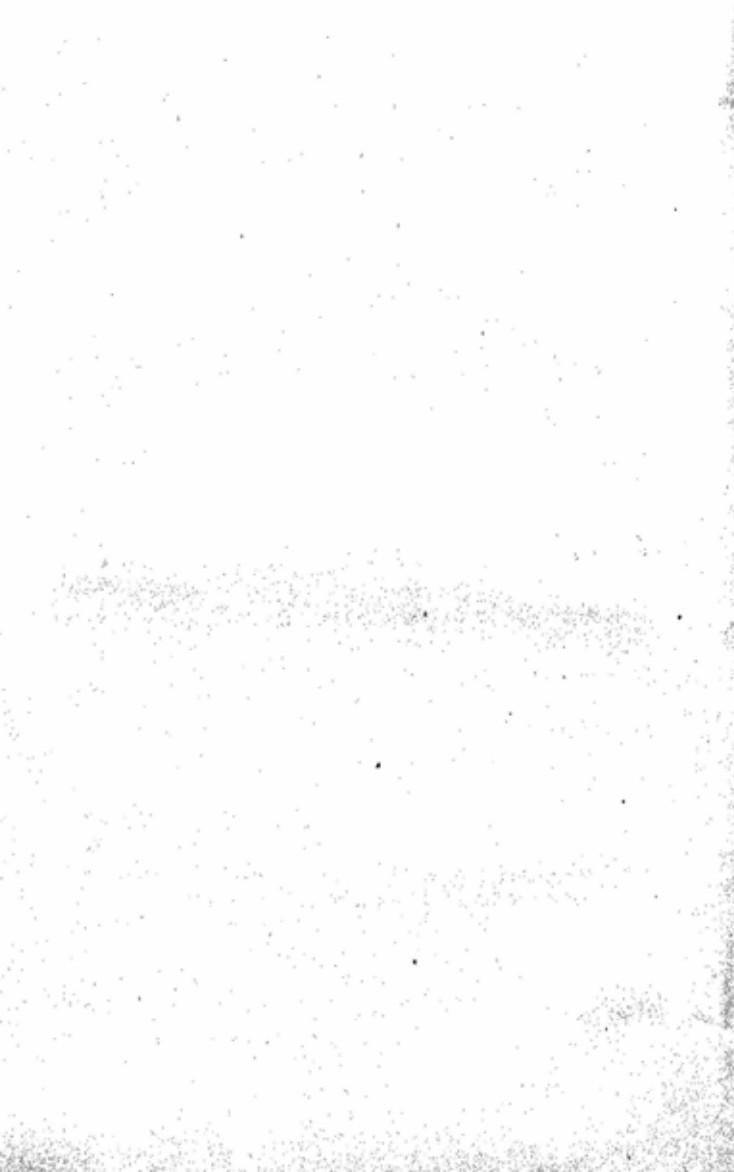
Let us now discuss the applied aspects of physical anthropology. It is used in industrial purposes, in selection of military personnel, in life insurance. It contributes in better designing of the machines men must use, the clothing of men, and the detection of the defects in the body and their correlations. The influence of this branch of science on the solution of many medical and legal problems is immense. The different disease resistances of different human groups and the conditions of temperature, humidity, etc. which are optimum for them are the most significant contributions of the physical anthropologists. Also the study of medical genetics has made more important contributions to the line of medicine in comparison to those of the earlier periods made by growth and development studies. The physical anthropologists have studied the race carefully and have done much in giving a blow to the race prejudice that are still found even in many advanced countries. Racial problem has been and is being discussed by the different scholars in this line and they are trying to driving out this particular disease from human society.

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PART TWO

COMPARATIVE ANATOMY





## MAN AMONG THE ANIMALS

*Man—a unique creation of the Nature—has caused a great sensation in the world. It would be the task of this chapter to find out his position among the animals. Who are his nearest relatives and what are their bodily features and behaviour?*

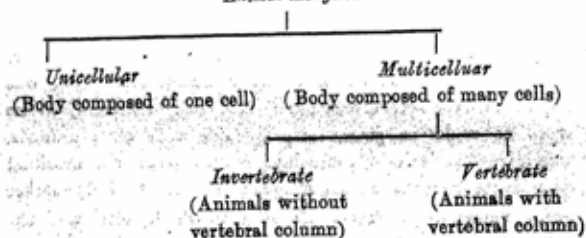
Formerly, it was a matter of humiliation to seek any sort of relationship between man and other animals. Man was regarded as the special creation of God and, therefore, in no way, he could be placed side by side with other animals. The learned societies of those days used to place the mankind quite apart from the *Animal Kingdom* and established another group, known as the *Human Kingdom*, in which, man was the only representative.

With the development of a few branches of science, e.g. Zoology, Palaeontology, Geology, Comparative Anatomy, etc, at the beginning of the 19th Century, a few scientists came forward demanding man's closer relationship with the higher apes. When Darwin, in his epoch-making book, 'The Origin of of Species', established the truth that man had originated through a gradual process of evolution from the simplest animals, and not by special creation, brought about a revolutionary change in the line of thinking of that period. Storms of controversies were raised from the different corners, and in due course, those were settled down, and it was gradually accepted that man belonged to the *Animal Kingdom*.

At present, we have seen clearly that the man is a biological species, and is a product of long evolutionary development. Now we are to find out the exact position of man in the kingdom of the animals.

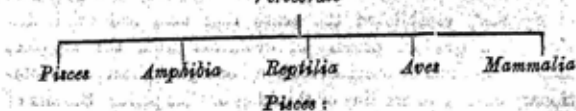
While examining the members of the Animal Kingdom, we find that some of them are very simple in physical characters, and some far advanced. The body of some animals are composed of only one cell, and in others we find many. There are so many animals, who do not possess any vertebral column and, therefore, they are known as invertebrates. The name 'vertebrates' has been given to those animals who possess vertebral column in their bodies.

Table I

*Animal Kingdom*

Man's body is composed of vertebral column and, therefore, he belongs to the group 'vertebrate', which, in turn, is divided into five classes, as shown in the Table below.

Table II

*Vertebrate*

These were the first vertebrates who appeared as fossils, in the Silurian deposits. The animals of this class are all aquatic in nature. The body may be covered with scales completely

or partly, or it may be naked. The limbs have been modified into paired fins which assist in swimming. The breathing is effected by the covered gills. Inside the body of the animals of this class the air bladders are commonly present. The body temperature is uncontrolled. During the winter season some fishes become inactive. Most of the fishes lay eggs that are fertilized outside the body.

#### *Amphibia :*

These were the second group of vertebrates who appeared as fossils, in the carboniferous deposits. Amphibians live in ditches, ponds, marshes, etc. Some of them are wholly aquatic; some live on moist land, in damp wood, etc. The amphibian animals breathe by means of external gills in the larval stage and by lungs, when adult. The skin is naked and it plays an important part in respiration. Most amphibians possess four limbs terminated by separate digits. The hind limbs are larger and comparatively thicker which are used for swimming and jumping. The body temperature is not controlled. During winter months the toads, frogs, etc. hibernate. Most of the amphibians are nocturnal in habit. The amphibians lay eggs that are fertilized either outside the body or these may be fertilized internally. All amphibians, except the viviparous species, pass through fish-like larval stage in water.

#### *Reptilia :*

The reptiles were the third group of vertebrates who appeared as fossils, in the late carboniferous deposits. Except a few species, all the reptiles are terrestrial and always lay their eggs on dry land. The body of these animals are characterised by the presense of horny scales or plates. The skin is dry. Most reptiles possess two pairs of limbs which have been adopted to meet various needs according to the habit of the animal concerned. In some of the reptiles, such as snakes the limbs are completely absent. The body temperature is not controlled. The snakes, lizards, etc. hibernate during the winter season. Most species of reptiles are diurnal in nature

and they show greater activities in bright sunlight. But the snakes are mostly nocturnal in habit. Breathing is always effected by the internal lungs. Fertilization is always internal. Most of the species lay eggs but a few, such as some snakes and lizards, are viviparous.

#### *Aves :*

The Jurassic bed has presented the first known birds which show many reptilian characteristics. Most of the birds are terrestrial. Some are amphibious and gather food in water. A few birds are oceanic, and they come on the lands to breed. All birds possess feathers on the body and scales on the legs. The skin is dry. The birds possess two pairs of limbs. The hinder pairs are well developed and adopted for various purposes such as running, climbing, swimming, grasping, etc. The digits are clawed. The anterior pair have generally been modified to form wings to assist the animal in flying. The power of flight is the unique characteristic in birds and owing to which they are able to wander about from one place to another. Almost all the birds are diurnal in habit but a few move about during the night. The body temperature is high and it is controlled. The breathing is effected by the lungs. All of the birds possess air-sacs in their body. The birds lay eggs which are provided with rigid calcareous shells. Almost all the birds incubate their eggs. After the hatching the young ones are generally looked after and fed by the mother or both the parents.

#### *Mammalia :*

Man is not included in the above four groups, as we do not find any of the above-mentioned characteristics in the body of man. But he belongs to the last class, i.e. Mammalia, on account of the following characteristics —

##### *A. Integumentary characters :*

(1) Presence of hair, a new type of integumentary unit, quite different from the other vertebrate groups.

(2) Presence of mammary glands for nourishing the young ones.

(3) Presence of sweat and sebaceous glands.

B. *Skeletal characters* :

(1) Presence of two condyles in the foramen magnum of the skull.

(2) The lower jaw is composed of the dentaries—only one pair of bones.

(3) The ribs articulate with the vertebrae by two heads—capitulum and tuberculum.

(4) Each vertebra is composed of three pieces of bones—the centrum and two epiphyses.

(5) Cartilagenous disc separates the centra of adjacent vertebrae.

(6) With few exceptions, mammals always possess seven cervical vertebrae.

(7) In the pectoral girdle the scapula articulates with the sternum by means of a clavicle. The coracoid is vestigial and the pre-coracoid is absent.

(8) Thecodont and diphyodont teeth, heterodont dentition, with differentiation into incisors, canines and molars.

(9) An epiglottis is found.

C. *Soft characters* :

(1) The body cavity is divided into two parts—an anterior thorax and a posterior abdomen—by means of a diaphragm.

(2) The heart is four-chambered and it is completely divided into two parts, each containing one auricle and one ventricle.

(3) The lungs are suspended freely in the thoracic cavity.

(4) The corpus callosum unites the two halves of the cerebrum.

(5) The pons varolii unites the two halves of the cerebellum.

(6) Presence of Pinna, an external trumpet.

(7) Ureter opens into the urinary bladder.

(8) The Red Blood Corpuscles are anucleated and circular.

(9) Homoithermous or warm bloodedness, constant or nearly constant body temperature.

(10) Presence of placenta, uterine gestation is the rule.

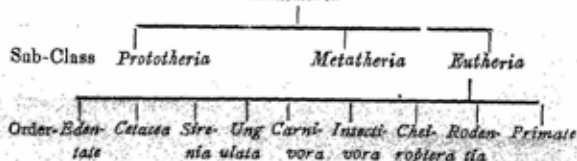
(11) Viviparity, the development of the young ones, except in monotremes, takes place in the uterus for sometime and are born alive.

(12) The cloaca is absent.

According to the anatomical features, the Taxonomists have broadly divided the class Mammalia as detailed below :—

Table III

*Mammalia*



*Characters of Prototheria :*

(1) They lay eggs and there is no uterine gestation ; these are Pre-mammalian characteristics.

(2) They have got a furry covering—an unique characteristic of mammals.

(3) Mammary glands are unspecialised and without nipples. Examples :—Duckbill ; Platypus.

*Characters of Metatheria :*

(1) Presence of marsupial pouch in the belly in which the young helpless offsprings take their shelter until they gain some strength.

Example :—Kangaroos ; Opposum.

*Characters of Eutheria :*

(1) Presence of placenta ; the embryo develops within

the body of the mother. During this time, food and oxygen go to the embryo by means of the organ known as placenta.

(2) Presence of two sets of teeth—deciduous or milk set, and permanent set.

Considering the above three sets of characters, we find that men can be placed in the last set, e.g. Eutheria, because they possess these features.

The section Eutheria is divided into a number of orders with its characteristic animals, who are more nearly alike and consequently more closely related. Here, by a process of elimination we can easily determine man's nearest relations among the orders of Eutherian mammals.

(1) *EDENTATA* :—In some of this order, the teeth are very degenerated and lack enamel, but few of them are completely toothless. The members of this order are very primitive in character and naturally they stand far from man.

(2) *CETACEA* :—These are the mammals who lead an aquatic life. The body is fish-like. The fore-limbs have modified into peddle-like structures and hind limbs have disappeared completely. So anatomically, man is not included in this order.

(3) *SIRENIA* :—These are also aquatic mammals with porpoise-like body on which there is a scattered covering of hairs. The animals of this order are herbivorous and very remote from man.

(4) *UNGULATA* :—These are four-footed ground-dwelling mammals. The main characters of these animals are the development of hoofs, a large portion of grinding (molar) teeth in relation to cutting and tearing teeth. They are generally herbivorous. In general feature these animals diverge widely from human type.

(5) *CARNIVORA* :—The name of this order implies that these animals live on flesh. It is characterised by a high development of cutting and tearing teeth, and sharp claws. Certainly man stand apart from this order.



(6) *RODENTIA* :—Most of the animals of this order are small and have a furry covering. They possess characteristically large, chisel-like incisors, and are used for gnawing into wood. Man cannot be placed in this order.

(7) *CHEIROPTERA* :—The fore-limbs of the animals belonging to this order are modified so as to support the wings. The bones have gradually been elongated and a broad web of skin extends to the hind limb, giving it an aerial life. Man can not be placed in this order.

(8) *INSECTIVORA* :—The name itself indicates that the animals of this order live on insects. They are usually small in structure and nocturnal in habit. Man stands far apart from this order.

From an examination regarding the nature and physical features of the animals of the above orders of Eutheria, we have come to the conclusion that man does not belong to the above orders, and at the same time, it has automatically been proved that he belongs to the remaining order, which is Primate.

### PRIMATE AND ITS CHARACTERS

In the year 1758 Linneaus, a Swedish naturalist, gave the name Primate which includes a number of Eutherian mammals, who develop some specialised characters, by which, they can be distinguished from all other animals. The order Primate includes Lemur, Tarsiers, monkeys, apes and man.

#### Characters :—

- (1) They have prehensile hands and feet adapted for arboreal life.
- (2) The digits of both hands and feet are provided with flat nails.
- (3) The thumb and great-toe are more or less opposable.
- (4) The collar bones or clavicles are well-developed.
- (5) They possess bony eye-sockets.
- (6) Teeth are specially meant for mixed diet.

(7) Keen and stereoscopic vision is a speciality of the Primates.

(8) The femur lacks third trochanter.

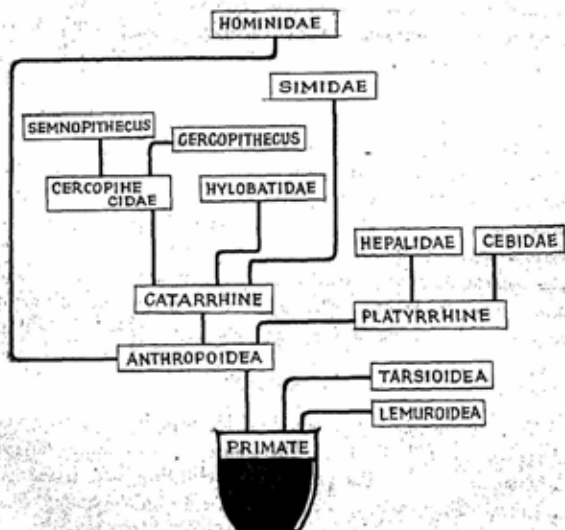
(9) They possess simple type of stomach.

(10) Two mammary glands situated on the thorax and they are pectoral in position. Some lowlier members of this order possess more than one pair of mammary glands.

(11) The testes descend into the scrotum.

(12) They possess highly developed and convoluted brain.

The order Primate includes various number of animals with various characteristic features. Man is also a member of the same order. This order can be further sub-divided into different sub-orders and families.



## I. PRIMATE AND ITS SUB-DIVISIONS

### LEMUROIDEA

The sub-order Lemuroidea has five families, with more or less seventeen genera and a varied number of species. Lemurs were found, both in the New and Old Worlds, during the Eocene time. Today the descendants of this sub-order are to be found only in the tropical regions of the Old World. The lemurs are small in size. The body is covered by a thick coat of fur. The tail is usually long and bushy; it is not prehensile but it plays the role of balancing. The eyes are lateral in position and are independent of each other. The tear duct opens outside the orbit unlike the Anthropoidea. The skull of the lemur is not balanced on the spinal column as is found in the case of man, but it is found suspended from occipital condyles. The brain is simple. The cerebral hemisphere is not highly developed and it does not cover the cerebellum completely. The frontal lobes are also very small. The teeth of the lemurs show some interesting features. They have, on each side of the jaw, two incisors, one canine, three premolars and three molars. The incisors and the canines are arranged in a row which resemble the teeth of the hair comb.

The hind limbs are most of the time longer than the forelimbs. The digits of both feet are provided with nails with the exception of the second one of the hind foot. It bears a claw. Both the thumb and the great toe are opposable. The lemurs lead an arboreal life. They are nocturnal and omnivorous in habit. The food consists of the different kinds of insect, fruits, leaves, eggs, etc.

### TARSIODEA

Tarsius, the small rat-like animal is the only representative of the sub-order Tarsiodea. These animals are mainly found in Malayan islands. They lead an arboreal life and nocturnal in habit. They have got a furry covering on the body. The tail is longer and it is bushy at the tip. All the digits, except the second and the third digits of the feet, are provided

with flat nails. The thumb and the great toe are opposable. The eyes are directed forward and the orbits are very large. The tear duct opens outside the orbit. The limbs are highly specialised. The fore limb is used for grasping and the hind limb for hopping movement when it comes on the ground. The tarsier can turn its head directly backward. The tarsier differ mainly from the lemurs in the following principal characteristics. The foramen magnum is more anteriorly placed in tarsiers than in lemurs. The cerebral hemisphere is more developed in the case of the tarsiers and these covers the cerebellum. The post-orbital wall is present in the tarsiers, while in the case of the lemurs it is not found.

It will be futile to seek man's position in these above sub-orders and, therefore, we should go beyond the Lemuroidea and Tarsioidae.

### ANTHROPOIDEA

The sub-order Anthropoidea includes the New World monkeys, apes and man. The eyes of these species are directed forward with tear-ducts present within the orbits. They have relatively large and complex brain. This sub-order is divided into the following series and families :—

#### (a) Platyrrhine :

It is characterised by a broad nasal septum. It is habituated in arboreal life. The dental formula of this series is—

i 2/2, c 1/1, pm 3/3, m 2/2 or 3/3.

This series is further divided into two families :—

#### HEPALIDAE :

The small squirrel-like marmosets are the representatives of this family. The body of these animals are covered with soft fur. The great toe is provided with claw. The other digits have flat nails. The thumb is non-opposable. The cheek pouch is absent, but the ischial callosities are noticed.

Dental formula—i 2/2, c 1/1, pm 3/3, m 2/2.

## CEBIDAE :

It includes large number of animals with different characters, e.g. the capuchin or Cebus monkeys, Spider monkeys, Squirrel monkeys, etc. The animals of this family possess digits with flat nails. The thumb is non-opposable. Both cheek pouch and ischial callosities are absent.

Dental formula—i 2/2, c 1/1, pm 3/3, m 3/3.

## (b) Catarrhine :

It is characterised by narrow nasal septum. The members of this series are herbivorous and fungivorous in habit, and they lead arboreal as well as terrestrial life.

The Old World Monkeys differ from the New World Monkeys in certain characters which are summarised below :—

*Differences in external characters :*

- (1) All the digits are provided with more flattened nails.
- (2) The thumb and the great toe are capable of independent movement.
- (3) The nostrils are closely situated to each other.
- (4) The tail is not prehensile.
- (5) All species possess ischial callosities.

*Differences in internal characters*

- (1) The bregma is forwardly placed.
- (2) The extension of pre-maxilla upto the nasal opening is noticed.
- (3) The articulation of jugal with the parietal bones never occurs.
- (4) The palate is long.
- (5) The bulla is not present.
- (6) The external auditory meatus is seen.
- (7) The basic cranial axis is short.
- (8) There are two pre-molars; the upper pre-molars are three-rooted and the lower, two-rooted.
- (9) The dental formula is i 2/2, c 1/1, pm 2/2, m 3/3.

The series catarrhine is divided into the following families and sub-families.

### CERCOPITHECIDAE :

It includes many genera and species. All of these animals possess ischial callosities. They have also cheek pouches. The hind limbs are longer than the fore-limbs. The tail is not prehensile and it may be short or long.

This family has got two sub-families :—the Cercopithecinae and the Semnopithecinae. The former includes macaques, baboons, etc. and the latter is represented by Proboscis monkeys, langurs, guerezas, etc. In the former sub-family the cheek pouch and ischial callosities are always found, the thumb is well-developed and the tail is of variable length. In the Semnopithecinae sub-family the cheek pouches are absent, the ischial callosities are small and the thumb is vestigial or absent. Most of the animal of this sub-family possess pouched stomach.

Dental formula—i 2/2, c 1/1, pm 2/2, m 3/3.

### MAN-LIKE APES (Hylobatidae and Simidae) :

This family includes the Gibbon, Orang-utan, Chimpanzee and Gorilla, as the members. The arms of these animals are longer than the legs. The chest is flattened. Cheek pouch and ischial callosities are not found. The tail is absent and this characteristic separates the man-like Apes from other animals of the Order Primate. The brain is large.

Dental formula—i 2/2, c 1/1, pm 2/2, m 3/3.

The man-like Apes can be divided into two sub-families—Hylobatidae and Simidae. The Gibbon and the Siamang are the members of the first, while the latter includes the other three apes—Orang-utan, Chimpanzee and Gorilla. The detailed descriptions of these apes have been given in the following chapter.

### HOMINIDAE :

It includes all the living varieties of man belonging to the single genus *Homo* and the single species *sapiens*. Man has

gone far from all other animals of the Order Primate owing to certain special features. He demands a special family for his own on account of the following principal characteristics.

(1) The cranium is large and the Foramen magnum of the skull is placed at the anterior region at the base of the skull. The head is neatly balanced.

(2) The chin is well-developed.

(3) The size of the canines are small and these generally do not project beyond the level of other teeth.

(4) The vertebral column has a forward convexity which is known as the lumber curve.

(5) The nose is elongated and well-developed. It is provided with a prominent bridge.

(6) The hind limbs are larger than the fore-limbs.

(7) The foot is arched both transversely and antero-posteriorly.

(8) The great toe is non-opposable. Unlike the anthropoid apes, the great toe in man lies in the same line with the other toes.

(9) The median furrow in the upper lip is a special characteristic. The lips are out-rolled.

(10) In comparison to the Anthropoid apes man's body is almost hairless and there is no tactile hairs or feelers.

Man has secured the summit position in the Animal Kingdom due to the following special features :

- A. Fully erect gait.
- B. Bi-pedal locomotion.
- C. Power of articulating speech.
- D. Highly convoluted brain.

### 3

## MODERN APES AND MAN

*Man's closest relatives are the modern apes—the gibbon, orang-utan, chimpanzee and gorilla. The critical study on the points of resemblances and differences of the modern apes and man has been taken up in the following chapter. Where does man stand in relation to these apes?*

The modern apes include the Gibbon, Orang-utan, Chimpanzee and Gorilla. The apes are man's closest relatives among the Primates, so far as the evolutionary tree is concerned. Now let us discuss the major anatomical features of the Great Apes and the man, and see what are the points of resemblances and differences.

### GIBBON

It is one of the smallest apes inhabiting in South East Asiatic Islands, viz. Java, Sumatra, Burma and Philippines. They are also seen in Southern China. There are about 12 varieties of Gibbon. The height of the Gibbon does not exceed 3 ft. and the weight of the adult Gibbon ranges from 11 to 15 pounds. There is no difference between the male and the female regarding size. The body of these animals are covered with fine woolly hairs, whereas, the hairs of Gorilla, Chimpanzee and Orang-utan are coarse. The colour of the hair is white, grey and sometimes black or a combination of these three colours.

At times, the Gibbons can stand erect. The arms are excessively long in comparison to the length of the leg. It is



said that during erect position, the finger tips of the Gibbons generally touch the ground. The Gibbon can pick up any material from the ground without stooping. Due to their adaptation of arboreal condition, the hands of the Gibbon especially the radius and the ulna, have elongated enormously. The hand is very long and narrow with a relatively short thumb, which is not perfectly opposable. With the help of the light and slender body, powerful arms provided with long fingers and short thumb, the Gibbon can easily travel through the trees with a free-swinging and pendulum motion. In length of leg, as compared to the trunk, the Gibbon exceeds all other anthropoids and stands next to man. The foot is elongated and narrow. The great toe will be found far apart from the other digits. This wide separation has an advantage in grasping the branches of the tree.

The head is large. The size and general appearances of the skull resembles those of the Cercopithecidae group. The brain case is larger in comparison to the face, which is short and provided with a flat and broad nose and thin lips. The forehead is low and the large and oval eye sockets are composed of thick bony rims. They have large canines and these interlock at the corners of the mouth. The temporal area of the cranium is rough, caused by the attachment of the temporal muscles. The cranial length of the Gibbon is 7.5 cm. The cranial capacity varies from 76-90 cm. It is greatly below than that of the higher apes, but higher than that of the monkeys.

The Gibbons are gentle and pleasant, and they live in small families, which is composed of the parents and the minor children. They can be kept as pets. Their food consists of fruits, leaves, buds, eggs, different kinds of insects and smaller birds, etc. The Gibbons possess ischial callosities which is the characteristic of the Old World Monkeys. In males, the ischial callosities are widely separated in two halves.

The Gibbon family can be divided into two groups—the *Hylobates* and the *Symphalangus*. The former includes the Gibbon proper and the representative of the latter group is the

Siamang, found only in Sumatra. The Siamang is larger in size than the Gibbon. The skull is long and the cranial capacity is larger than that of the Gibbon. They have laryngeal air-sacs. According to some scientists the Siamang represents an intermediate form between the Gibbons and the Giant apes.

### ORANG-UTAN

The Orang-utans differ very much from the Gibbons in their bulky and powerful bodies. They are found mostly in the islands of Borneo and Sumatra. In erect position, the animal is nearly 5 ft. high. The weight of the adult males varies from 165 to 200 pounds. The females are somewhat higher. The body of the Orang-utan is covered with long, coarse hairs, of reddish-brown colour. No hair is found on the face, ears, palm and soles. The chest is barrel-like. The breasts are found situated laterally with the nipples, in front of the armpits. The hands are long and narrow, with elongated fingers. The thumb is small and all the digits have flat nails. The forearm is much longer than the upper arm. The legs are short and the foot is long and narrow. The great toe is opposable and very small.

The head is large, with a high and rounded forehead. The brain-case is small in relation to the large head. The orbits are elliptical in shape. The average cranial capacity is 416 c.c. The nasal bones are small and the bridge is not elevated. The root of the nose is very narrow. The jaw of Orang-utan is extremely large and it projects forward. The jaws are provided with long and tusk-like canines, which interlock.

The Orang-utans are arboreal in nature. They live on trees by building nests on the branches. They walk on all fours, when they come to the ground. The whole body of Orang-utan is built in such a manner that it can enjoy the arboreal life to a lesser degree than the Gibbon, but to a higher degree than the two other apes.

The food of the Orang-utan consists of leaves, different

kinds of wild fruits, insects, etc. The Orang-utan is represented by a single species.

### CHIMPANZEE

The body of the Chimpanzee is not so well-built as we find in the case of the Orang-utan and the Gorilla. The Chimpanzees are found in large number in the tropical forests of Africa. There are three species of Chimpanzee, viz. the white-faced or common Chimpanzee; the black-faced, bald-headed Chimpanzee; and the pygmy Chimpanzee.

The body proportion of the Chimpanzee shows some tendencies towards that of man. The average height of the full-grown males being 5 ft. The weight of the adult male and female are 110 pounds and 88 pounds respectively.

The body is covered with long and coarse hairs of various colours. There are no hairs on the face, hands and feet. The heads of the bald-headed Chimpanzees are devoid of hairs. Most species of the Chimpanzee have round low-vaulted heads. The average cranial capacity is 400 c.c.; there is a poor development of supra-orbital ridge and it is continuous. The nasal bones are very small, the bridge is not elevated, and the tip of the nose is not like that of man. In Chimpanzee, the forward projection of the jaw is clearly seen. The canines are large and projecting but they are smaller in comparison to those of the Orang-utan and the Gorilla. The lips are thin. The general appearance of the skull is ovoid; the facial region is small in proportion to the skull. The orbits are elliptical but not so as we find in the case of the Orang-utans.

The hand of the Chimpanzee is elongated and narrow. The fingers are long and the thumb is small and opposable. The legs are long and these are larger than those of the Orang-utan. The foot is long. The hind limbs of this animal are poorly adapted for walking upright. The great toe is opposable and it is not in line with the other toes. The heel is rudimentary. In erect position, the hands of the Chimpanzee generally reach upto the knee-level.

The Chimpanzees are very expert in climbing and brachiating. They build nests on the trees and sleep there during the night. The food of the animal consists of fruits, different vegetable products, eggs, small birds and sometimes rodents also.

## GORILLA

Among all the primates, the Gorilla is the largest and stoutest. They are found in equatorial regions of Africa. The Gorillas are represented by two species—the Western, Coastal or lowland Gorilla, and the Eastern, or mountain Gorilla. The former inhabit mainly in the region of Gaboon and the Cameroons while the latter group is found in the region of the eastern Congo, West of Lake Edward and Lake Kivu.

When the animal stands erect, the hands go below the knee-joint. The height ranges from 5 ft. to 6 ft. in lowland Gorillas, and 5 ft. 3½ inches to 5 ft. 10½ inches in mountain Gorillas. The weights of the body of adult males range from 350 to 600 pounds.

The body is covered with the long and black-coloured hairs. The face, palms and soles are completely devoid of hairs.

The massive skull of the Gorilla is a note-worthy feature. Above the eye openings, an enormous supra-orbital torus goes from left to right side of the skull. The forehead is very low. The general appearance of the skull is more or less oval and there is a prominent sagittal crest. It is weaker in females. The average cranial capacities of the males and the females are 550 c.c. and 450 c.c. respectively. This big cranium consists of solid bones and there is little space for the brain. The facial portion is larger in proportion to the cranial part. The jaws are large and projected forward and downward. The upper jaw is prognathous and the lower jaw is massive. The size of the canines are enormous and they are interlocking. The nasal bones are long, low and narrow; the bridge is slightly elevated. Nostrils are broad and forwardly

directed, and these are covered by cartilagenous rings mostly like nasal wings but not so developed as we find in man. The lips are thin and the chin is completely absent.

The manus of the Gorilla is more human in different features than in other anthropoid apes. The upper arms are longer than the forearms and, therefore, it differs from the Gibbon, the Orang-utan, and the Chimpanzee. The hand is shorter and broader than in other apes, and the thumb is well developed. On the whole, the hand of the Gorilla resembles that of man than that of any other ape.

The leg is short. The foot of the Gorilla also resembles that of man in many respects. The thumb is opposable and it is set apart from the other digits. The heel is more or less well-developed. The anatomy of the foot of the Gorilla speaks that it is less adapted for arboreal prehension. The Gorillas spend most of their times on the ground. They climb on the trees also, build their nests and pass the nights there. Sometimes they can walk erect but their usual gait is obliquely quadrupedal.

The food of the Gorillas consists of fruits, leaves and different kinds of vegetables.

*Difference between the Mountain Gorilla and the Lowland Gorilla.*

The mountain Gorilla differs from the lowland Gorilla in the following characteristics—narrow skull, longer trunk, larger face, shorter limbs, shorter and broader hands, body covered by thick and black-coloured hairs etc.

### MODERN MAN

Our own type—the *Homo sapiens*—has spread and multiplied over the whole world within the past 70,000 years. All the living varieties of mankind stem from a common background. But as they settled in different environmental conditions, they acquired distinctive traits. On the whole, man possesses certain unique characteristics, which have

helped him to surpass all other animals and thereby establish a new genus *Homo*.

The relative lightness of the bones is one of the features in man. The skull is the large bony case situated at the anterior or upper extremity of the vertebral column. The skull consists of two parts—the cranium and the face. The former is a large and hollow case in which the brain is placed. The brain is complex and its all the parts are relatively enlarged. In size it is from  $2\frac{1}{2}$  to 3 times as large as that of gorilla. In man, the brain constitutes about one forty-sixth of the weight of the body. The height of the face is short. It is nearly at rightangle to the base of the skull. There is wide spheno-maxillary suture. The pre-maxilla is never marked off from the maxilla by a definite suture. In most of the mammals the snout is the first of the body that comes in contact with a foreign object, and the sense of smell is most important, while in man, we find that the snout has vanished and the sense of smell is also diminished. But, on the other hand, the power of sight has been increased. Our vision is stereoscopic. The orbit is more or less rectangular. In the orbit, we find the articulation of ethmo-lacrymal, ethmo-sphenoid and spheno-parietal bones. The forehead is bulging and the supra-orbital ridges have been diminished. The nose is prominent and it is raised out of the plain of the face. The nasal bones are short, wide and fused. The fleshy tip of the nose is made of osteo-cartilagenous framework. The lips are outrolled and the mucus membranes are visible. The upper lip is provided with a median furrow, which is the unique characteristic of man. As regards teeth, we find that they have undergone a great change due to the nature of diet. Man's teeth today are used for dealing with a far wide range of food. The canines are diminished in size and they do not extend beyond the level of the other teeth. In general, all the teeth become relatively small and close together. The molar have been modified to a great extent for grinding. The roots are not divergent. The alveolar border is parabolic in shape.

The chin is well-developed. In man, the unique characteristic regarding the skull is that it is well-balanced. The spinal cord enters into the foramen magnum of the skull which is situated centrally at the base of the skull. The skull of man is so neatly balanced that there is slight necessity of nuchal muscles to bind the head in proper place. Due to lesser quantity of nuchal musculature, the neck of man is prominent. The average cranial capacity of man ranges from 1800 c.c. to 1450 c.c.

The adaptability of man is seen greatly in the remarkable nature of the limbs. The arms are shorter than the legs. This has resulted due to the bi-pedal locomotion. It is believed by the scientists that our ape ancestors developed the ground-living habit when a vast jungle area became treeless due to a climatic change. Walking erect requires an enlargement of the legs. The ridges for muscle attachments on the bone are much more defined than as we find in the apes. The foot has also changed. The great toe is not opposable, i.e. we cannot use it for grasping anything, as we usually do with the help of our thumb. Innermost digit is the most dominant one. The metatarsals are bound together by powerful transverse ligament. The lateral toes are reduced, the fifth becoming a rudiment. The man possesses well-developed heel. In the case of man, we see that the legs are strictly used for walking as the arms for other purposes.

The pelvic is bowl shaped and the transverse diameter is greater than antero-posterior diameter.

The sacrum becomes short and broad. The ilium is short and the iliac crest becomes more curved. Acetabulum is seen nearer to the pubic symphysis. The vertebral column has four curves, while in apes we find two of such.

Man's body is more or less hairless in comparison to the apes and monkeys. The unique characteristic of man is that there is no tactile hair on his body.

The upright position, bi-pedal locomotion, complex brain, hairlessness, excellent eye sight, power of speech—all these

factors have jointly given man a better place in the animal kingdom and thereby he establishes a new genus *Homo sapiens*.

## APES AND MAN

### *A Comparative Analysis*

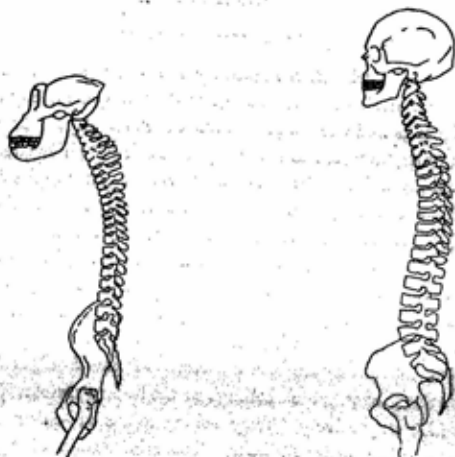
Darwin's declaration regarding the descent of man from non-human ancestors caused a great deal of controversy among the scientists and the general public of those days. It was a matter of degradation to draw any line of relation between the apes and man. On getting Darwin's view regarding the descent of man a lady cried, 'Descendant from the apes! My dear, we will hope that it is not true. But if it is, let us pray that it may not become generally known.' However, in due course, with newer inventions and discoveries in this line, Darwin's view was accepted by all and thereby the people were forced to embrace their strange relatives.

Apes and men are the members of the families *Simiidae* (except the gibbon which belongs to the family *Hylobatidae*) and *Hominidae* respectively. They belong to the sub-order *Anthropoidea* and the order *Primate*. The relationship of apes and men will best be understood if attempts have been made to study the various anatomical features critically.

The skulls present many contrasting features which should be studied with care. The skull of man is highly developed in the frontal region. The forehead of man extends almost vertically in the upward direction. The supra-orbital ridge is not so developed, and it may be feeble, trace or moderately developed. No transverse crest is present in the sagittal plane of the skull. The maxilla and pre-maxilla have been fused. The foramen magnum is situated centrally at the base of the skull. The head is well-balanced and, therefore, the face is vertical. The line of muscle attachment is seen far lower on the back side of the skull. In ape, the forehead is less developed and the head slopes backward. The supra-orbital



torus is highly developed and prominent. Transverse crest in the sagittal plane is seen. Unlike man, the maxilla and pre-maxilla are separately developed. The foramen magnum



The Skull and the Vertebral column of ape and man.

is seen further backward at the base of the skull. It is for this reason the ape's face hangs forward. The line of muscle attachment is seen high up in the backward part of the skull.

The lower jaw of man is small in size in comparison to those of the apes. The muscle responsible for the movement of the lower jaw is weak. In man, there is always a well-developed chin. Man's facial portion never project forward but the prognathism of the lower jaw is sometime noticed though very rare. Ape's lower jaw is massive and there is no trace of chin. The muscles for the movement of the lower jaw is strong and well developed. Facial prognathism is very common among the apes.

The teeth in man are smaller in size than those of the apes. The canines do not project forward beyond the level of the



The Lower Jaw of ape



The Lower Jaw of Man

other teeth. The chewing motion in man is from side to side



The Dental arch of ape

The Dental arch of man

and also up and down—generally known as the rotary motion. The dental arch, in the case of man, takes the shape of a

parabola, whereas in apes, it is U-shaped. In apes, the size of the teeth are larger and the canines project beyond the level of the other teeth. Due to this nature the canines of the apes interlock when the jaws are closed. This arrangement prevents the lateral movement in chewing. The chewing motion in ape is only up and down. With the shortening of the canines man has developed a new rotary motion.

The nose in primate is composed of two parallel bony plates, united by a suture in the middle line. From these nasal bones extend the cartilaginous nose which is divided into two separate chambers—the nostrils—by the septum. In man, the nose is well developed. The root and the bridge of the nose have a slight to marked elevation and the cartilaginous portion is seen well above the surface of the nose. The tip of the nose, in man, has a thick bulb that overhangs the septum. The nasal wings are strongly developed, but they do not grow under the long axis of the nose to form the lower borders of the nostrils as is found in the case of the gorilla. The nostrils are smaller and they generally point downward. The elevation at the root and bridge in ape's nose is very little or absent. The cartilaginous portion of the nose is very wide unlike man, and it is little raised on the surface of the face. The tip of the nose is lacking in apes and, this is why, the nostrils have become prominent and look like two large holes.

The lips of the apes are seen stretched over their bulging jaws and they are loose and protrusive. The ape's lips are thin as the red portion of the lip is scarcely seen when the mouth is closed. The integumental lip has little quantity of fat. In man, the integumental upper lip shows a median furrow which starts from the nasal septum and continues upto the edge of the membranous lip. This median furrow is the characteristic feature in man. The lips vary from thin to very thick.

In apes, the arms are greatly elongated, an adaption to the habit of hanging and 'walking' in branches. This type of walking by arm of the apes has been termed by Keith as 'brachiation.' He has also explained that during locomotion the

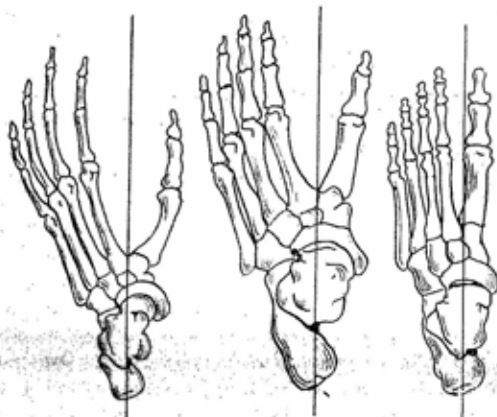
apes grasp a branch and throw the body upward by flexing the arm. In this type of lever movement, the weight is suspended from the shoulder joint and the fulcrum is at the elbow joint. The power is applied to the upper arm which acts as the movable lever. But in the case of man, the different mode of use of the arm is seen. He uses it for lifting weights. At this time the fulcrum is at the elbow joint and the power is applied to the forearm which acts as the movable lever. In apes, the upper arm acts as movable lever and, therefore, becomes short, whereas in man the forearm is the movable lever and has experienced shortness.

The femur of ape is short, thick and curved, whereas in man it is long, slender and elongated. Due to this, the ape walks with a shambling gait. The ridges for muscle development in femur are greatly developed in man than in apes. The *linea aspera*, a rough ridge at the back side of the femur, is the characteristic feature in man. It has resulted due to the great development of the extensor muscles which play a most important part in the erect posture and bi-ped gait. Owing to the great development of the ridge, the cross-section of the human femur gives a prismatic form, while in apes it is round and oval.

The foot of man has witnessed remarkable changes due to his new mode of locomotion. The foot supports the weight of the body and helps in standing and walking erect. In ape, the foot is used in locomotion as well as in grasping the branches of the trees. The great toe, in man, is non-opposable. It lies in the same line with the other digits. The lateral toes have been reduced in size and the fifth one has become very small. But in the case of apes the great toe is opposable and it is not in line with the other digits. The lateral toes are well-developed in apes. Unlike the ape, man's foot is arched transversely and antero-posteriorly.

As regards stature and weight the apes vary. The gibbon is the smallest among the apes and its average height and weight are 3'0" and 14 to 18 lbs respectively. The orang-utan attains

the average height of 4'6" and weight about 165 lbs. The chimpanzee and gorilla are considered as the tallest among the apes. Their average heights are 5'0" and 5'6" respectively. The weights of the adult male and female chimpanzee are 100 lbs and 88 lbs respectively. The average weight of the

*Chimpanzee**Gorilla**Man*

The structure of the feet of apes and man

adult male gorillas ranges from 350 to 650 lbs. The average height of man is about 5'6" and the average weight is 145 lbs. The vertebral column of man possesses four alternative curves which help in supporting and transmitting the weight of the head and trunk in erect posture. In apes, the vertebral column has two such curves.

In brain development man shows more advancement than the apes. The brain in man is not only much larger than that of the ape but it is highly developed. The weight of man's brain is three times as heavy as that of the gorilla, the largest ape. The forntal region of human brain is especially developed and the cerebrial cortex presents a much more complex convolutionary

development than those of the apes. But it should be kept in mind that the structural difference is totally one of degree. Different research works on cerebral localization in the gorilla and the chimpanzee reveal that the motor area are essentially the same; the main difference is the far greater expansion of the association areas in man. According to Tilney, the microscopic structure within the brain stem of the apes is identical with those of man. The brain-case in man is largest in capacity which ranges from 1300 to 1450 c.c. The average cranial capacities of the gorilla, chimpanzee, orangutan and gibbon are 549 c.c., 400 c.c., 416 c.c. and 98 c.c. respectively.

Man is distinguished from the apes mainly by his power of articulating speech which is a unique characteristic feature found in man. But there are some scientists who have felt the use of some sort of language among the apes. G.L. Garner, after studying the apes, has described that the various sound of the apes stand for words. He goes to an extent of saying that the vocal language of the monkeys and apes differs from those of man only in its complexity and degree of development. According to Yerks, the chimpanzee has a sign of language and it means 'no' by the movement of the head. The failure of the chimpanzee in articulating proper language is not due to structural inadequacy of the organs but it is due to the lack of development of the elaborate brain mechanism responsible for speech. Yerks has tried to teach two chimpanzees to speak but to no effect. According to him, the apes have plenty of things to talk but they have got no vocal expression.

It has been seen that there are differences and resemblances in the characters of man and apes. According to Huxley, 'whatever system of organs be studied, the comparison of their modification in the ape series leads to one and the same result—that the structural differences which separate man from the gorilla and the chimpanzee are not so great as those which separate the gorilla from the lower apes.' After critical study he comes to the conclusion that in the sum total of classificatory characters the apes are most like men. Recent studies about the

physiological features of the apes reveal that the uterus and also the placenta of apes are human in their structural detail. The placenta is single as is found in the case of man. The physiological sexual rhythm in female chimpanzee is identical with that of man. Serological studies point out the close relationship between the apes and man. The earlier precipitation test of Nuttall revealed that the blood of chimpanzee was indistinguishable from that of man. But the recent and more delicate method of Landsteiner advocates a slight difference. However, a close resemblance exists between the blood of apes and man. It has also been found that the diseases of man e.g. typhoid fever, bacillie and amoebic dysenteries, cholera, syphilis, etc. may be transmitted to the chimpanzees and other apes.

#### **Anatomical similarities and dissimilarities in man and apes**

We know that the apes are man's nearest kins among the Primates. Each of the four apes shows some resemblances, as well as differences with man. In the succeeding lines, attempts have been made to summarise the like and unlike anatomical characters of man and apes.

#### **Gorilla and Man**

In hands, feet, pelvis, and in size of brain, the gorilla shows close relationship with man. But the massive jaws of the gorillas have no resemblances with those of man. In this character, the gorilla and man go far from each other.

#### **Chimpanzee and Man**

The chimpanzee and man relate to each other to a great extent by means of the likeness of the skull and the pigmentation of the body. The chest proportion of the chimpanzee is mostly human.

#### **Orang-utan and Man**

In his high forehead and the same number of pair of ribs, the orang-utan demands a closer relationship with man, than all other apes. On the other hand, the two factors like

the shortness and degenerate character of the legs and the adaption of the feet for suspension, separate these two individuals from each other.

### Gibbon and Man

The length of the legs and the erect gait of the gibbon indicate the closer anatomical relationship with man. But in other characters, such as, the excessive arm-length, general size, pelvis, hands and feet, length of canine teeth, and the size of the brain, the gibbon goes farthest from man.

In a comparative anatomical study among man and the four apes regarding 57 characters, Prof. A. Schultz comes to the conclusion that man resembles the gorilla, the gibbon, the chimpanzee and the orang-utan, in 23, 15, 12 and 7 characters respectively. It would not be wise to draw the inference regarding man's closest relative from the above figures. While trying to establish the closer relationship among the said individuals, it is better not to depend on one type of characteristics, which is done here. It is very difficult to find out the closest relative of man among the apes, if all the characters, e.g. anatomical, physiological, anthropometric and mental are taken into consideration. Among the four apes, it is seen that each of them develops one or more special features, with which it can demand the closer relationship with man.

### INTELLIGENCE AND SOCIAL LIFE OF APES

Man is an intelligent animal. With this intellect he has invented and discovered various facts and objects in his daily life which have helped him in securing the highest position in the kingdom of animals. Different experimental studies have been made on the mental behaviour of the great apes, man's nearest relatives, and it has been concluded that the apes, especially the chimpanzee, are far superior in intelligence to the other primates, and in their mental operations they are qualitatively more like man. Prof. R. M. Yearks has conducted a detailed and careful work on the mental attitude of a young orang-



utan named Julius. After his study, Yearks remarks that, 'as compared with monkeys and other mammals, the orang-utan is capable of expressing free ideas in considerable numbers and of using them in ways highly indicative of thought-process, possibly even of the national order. But contrasted with that of man, the ideational life of the young orang-utan seems poverty-stricken, certainly in this respect Julius was not above the level of the normal three year old child.'

Dr. Kohler after an experimental study on the chimpanzee expresses his opinion in favour of the result of Yearks. His chimpanzee showed some sort of intelligence in obtaining fruits by means of sticks, boxes piled on another and in other ways. According to Kohler, the intelligence of this ape ranks between that of man and that of lower mammalia but is much nearer the latter. Mrs. Ladygina-Kohts studied a young chimpanzee and engaged him in matching objects and colours. In her study Ladygina discovered that the chimpanzee could be able to match the same correctly upto 15 seconds after the sample was removed from the sight. No detailed work on the gibbons have yet been carried out regarding the intelligence. Boutan has worked on a gibbon and has tried to engage him in the solution of various problems including the opening of trick boxes for securing food. It has been seen that the gibbon is inferior in manual dexterity to all the other apes. In most of the cases they show far less intelligent behaviour than the other three apes.

Dr. Zuckerman studied the different behaviour patterns of the apes and found that they lived in a social state. The behaviour of the apes and monkeys has attracted the attention of the various authorities who deal with the human social activities. Herbert Spencer studied the animal behaviour and recorded his observations in 'Principles of Sociology' where he says, 'Among sundry of the primates, gregariousness is joined with some subordination, some combination, some displays of the social sentiments. There is obedience to leaders; there is union of efforts; there are sentinels and signals; there is some

idea of property ; there is some exchange of services ; there is adaption of orphans ; and anxiety prompts the community at large to make efforts on behalf of 'endangered members'. Dr. Westermarck in his monumental book 'History of human marriage' advocates that the institution of marriage has developed out of 'primeval habit'. Instances of family relationships that are found among the apes and monkeys are numerous. It has been reported that most species of the monkeys live in bands of from ten to fifty or more, and they may co-operate in mutual defense or in keeping watch. Baboons are generally seen in herd of a few hundreds. Sometimes the herd is seen engaged in work on co-operative basis. It is reported that they co-operate in raiding fruits of the garden, in defending themselves against some ferocious animals, etc. Gibbons are also seen in small bands. Tickell saw the gibbon in parties from eight to twenty individuals. During his observation he hardly came across a solitary gibbon except an old male who stayed apart from the flock. Speath had observed that in most of the time gibbon lived in bands. But one day he came across a band of males only on the branches of a tree which he described as some sort of bachelors' club gathering. The gibbon males do not dominate their wives. The gibbon mother does not ordinarily support her new born infant with her hands as it clung to her. She does not instruct it in walking, or climbing on the tree as is found in the case of the chimpanzee mother. There is no evidence that the gibbons build nests at night as is generally found among the large apes.

The orang-utan is the least sociable among the apes. Generally they are not seen in groups larger than a family party. Dr. Crespigny observed orang-utans living in parties consisting of one adult male, one adult female and an young individual, but the male one does not occupy the same tree. Deschamps suggests that the oranges remain in small and scattered groups because of the scarcity of food. Regarding the family of the oranges some say that it consists of a male, a female, and their young ones. Others are of opinion that the male is solitary.

except in mating season ; but there is doubt that the orangs have only one particular yearly breeding period.

The chimpanzees are more human than all the other apes. It has been reported that the chimpanzees live either in single family group or in bands larger than those of the gorilla. Garner, during his observation on the behaviour of these apes, noted the chimpanzees in parties of eleven, five, three or two. Some of the observers including Garner also met with solitary males. Buck described from his experience a fine family unit of chimpanzee which consisted of an adult male, two adult females, one of whom was nursing, and about eight immature. The family mentioned came to its camping place for the night when Buck made his observation. Christy holds that the chimpanzee build a new sleeping nest on the branches of the tree every night. Aschmeier, during his observations, noted that three chimpanzees were preparing a bed in the tree ; one of them, a male, was not participating in the work, but he was only looking after the job. The internal features and movement of the large troops of the chimpanzee have not yet clearly known. Garner gave a fine account regarding the carnivals observed by bands of chimpanzees. A kind of drum was built by them out of clay. It was constructed on a hollow pit which acted as resonance cavity. When the drum was quietly deried up, the chimpanzees assembled in great numbers during the night and the carnival began. One or two of them beat the drum violently, and the other began to dance in a wild manner which continued for several hours. Kohler also observed the dancing of two of his chimpanzees. He noted that sometimes the movements and rotations in the dancing were so rapid and so unique that it resembled the dancing technique of man.

Gorillas are found in small bands which vary in size from four to nearly fifty individuals. Sometimes adult males are also seen roaming alone. Generally it is seen that in small band there is only one adult male, but the number increases in the case of the larger troop. Most of the observers point out that the gorilla is polygynous. But Reichenow and Von Koppenfels are of opinion that the Gorilla is monogamous. Their opinion is

based on the keen observation of certain nests of the gorillas. Barns, Akely, Jenks, Chorley, etc. do not agree with the opinion of Reichenow. Chorley observed a family of mountain gorilla in Uganda which consisted of an adult male, four adult females and two young individuals. It is very difficult to say with certainty whom of these two groups of observers are correct. The presence of solitary adult males, the fact that most of the observations indicate a preponderance of females in bands, and that the bodies of the gorillas, chased or captured by the hunters, generally present clear evidence of terrible fighting, are consistent with the possibility that family unit are dependent on the dominance of their male overlords. According to Dr. Westermarck, 'the gorilla lives in family groups, consisting of one adult male....., one or more females, and one or more young ones of different ages,.....the adult male, or father, guards warns, and protects his family, and apparently, builds a nest for them'.

The above account, though in an outline form, reveals the fact that family life can be seen even among the non-human groups. 'The family', says Dr. Westermarck, 'implying marital and paternal care, was hardly less indispensable for primitive men than it is for the gorilla and chimpanzee.' But Malinowski strongly opposed this view. In his book 'Sex and Repression in savage society' he refused that any 'type of human organisation can be traced back to gregarious tendencies.' Miller also did not support the theory that man had inherited the idea of family life from his primate ancestors. Some are of opinion that human society differs fundamentally from the animal society and, therefore, it is futile to trace any analogy between these two social groupings.

## THE STORY OF MAN'S EVOLUTION

*The question regarding man's origin had been stirring up the minds of the people at the different cultural levels from the earliest time. All the answers to that question were then packed up with various miraculous stories. But, in due course, the scientists have been able to prove that man is a result of long evolutionary development. When, how and where the evolution of man took place ?*

### THE ORIGIN OF MAN

Man appeared on the face of the earth not as a result of special creation as believed by many people of the 18th Century and earlier. The facts regarding man's origin were then crowded with legends and miraculous stories. But the scientific minds could not satisfy with the legends and stories about the origin of man. It was as early as the beginning of the 19th Century, that the scientists began to unveil the mystery of their own origin with their limited knowledge in this particular line. The development of Zoology and Comparative Anatomy reveals the fact that man has resulted due to a process of organic evolution, which is nothing but the development of organisms from simple and homogenous to complex and heterogenous forms. Then the development of another branch of science viz. Palaeontology has made these workers more accurate in reconstructing the past history of mankind. Palaeontology deals with the different

aspects of fossilised animals and plants, and, naturally it will help those who wish to study any kind of lost history by means of fossils. The different layers of earth have carefully recorded the descriptions of the unwritten days of man's life on earth. The earth itself can be compared to a large book in which there are so many pages, such as the different strata. In these pages of the large book are 'written' the story of man's past by means of fossilised remains of plants and animals. These writings of Nature can be read correctly by the Palaeontologists with the help of the Geologists. The Geologists help in ascertaining the time sequences and interpreting the fossil data. The joint study and analysis of these two groups of scientists, have thrown some light on our darkest past and they have already been able to show the great antiquity of man from different findings.

At the beginning of the 19th Century, fossilised bones of some ancient animals associated with dressed stone implements were discovered by different Geologists and Archaeologists. But protests were raised from the different corners about the establishment of the antiquity of man with the help of those mere evidences. But the scientists did not pay any heed to those cries and they firmly believed that man's past life would properly be unfolded some day in future by further researches in that line.

The controversy regarding the antiquity of man raised its peak when Boucher de Perthes, a French Custom Official, unearthed, in the year 1846, a few dressed flints, in the ancient gravels of Somme near Abbeville. He firmly declared that those rude stones had been shaped by human hands. Boucher de Perthes received whole-hearted support from Dr. Rigollot of Amiens, who discovered a few rude stone implements in the sand-pit at St. Acheul in 1854. But Boucher de Perthes' claim regarding the antiquity of man was opposed vehemently by many learned people of those days. Yet he did not lose his heart and carried out further research work in that particular line. In 1859, a batch of British scientists visited the site where Boucher de Perthes made the discovery. After returning

home the scientists made an announcement accepting Boucher de Parthes' claim regarding the antiquity of man. Also, in the same year, Charles Darwin published his epoch-making book, *The Origin of Species*, in which, he established the facts, supported by reliable evidences, that man had appeared on earth due to a gradual process of evolution. The year 1859 is remarkable in the history of mankind as it has brought a revolution in the line of thinking.

In order to have a general idea about man's evolution, some knowledge of the sequence of formations deposited upon the earth's surface and the different forms of life present in these layers is necessary. The different layers of earth have been arranged chronologically with the characteristic fossil remains of plants and animals. These layers are to be studied from below upwards. After analysing the results of the joint study conducted by the Geologists and the Palaeontologists, we come to know that the life had originated long long before in the simplest form, which gradually became complicated after going through a process of evolution. From the table below, we may get an idea about this fact.

Table IV

Palaeontological period.	Geological period.	Characteristic animal forms.
CAINOZOIC	Recent	Development of modern mammals and birds.
	Pleistocene	
	Pliocene	
	Miocene	
	Oligocene	
	Eocene	
	Cretaceous	True birds ; Placental mammals.
MESOZOIC	Jurassic	Early birds ; Giant reptiles.
	Triassic	Early mammals-Great development of reptiles.

Palaeontological period.	Geological period.	Characteristic animal forms.
PALAEOZOIC	Permian	Early mammal like reptiles.
	Carboniferous	Numerous insects, traces of reptiles.
	Devonian	Spiders, Amphibians
	Silurian	Fishes
	Ordovician	Jawless fishes
	Cambrian	Molluscs, Crustacea
ARCHEOZOIC	Pre-Cambrian	Different types of worms.

Table V

Palaeontological period.	Geological period.	Characteristic animal forms.
CAINOZOIC	Quater- Recent nary (Age of Man)	Different races of man. Present-day animals.
	Pleistocene	Earliest types of modern man.
	Tertiary (Age of mammals)	Different types of Primates.
	Pliocene	Different humanoid types. Generalised ancestors of the present Anthropoid Apes.
	Miocene	Generalised anthropoid ancestors of Great Apes and sometimes of man also.
	Oligocene	Primitive types of anthro- poid apes. Carnivores, Insectivores, Rodents and other mammals.
	Eocene	Early types of Lemuroids, Tarsioids. Different placen- tal mammals.



The Cainozoic era is most important to the students of physical anthropology, as it is marked by the evolution of mammals and of man. It is divided into two main epochs, viz., Tertiary and Quaternary which, in turn, is again subdivided into four and two periods respectively. Mammals first developed in the Eocene period, the first phase of the Tertiary. Lemurs and Tarsiers are the two characteristic mammals of this time. The succeeding Oligocene period is characterised by the development of the most ancient Tailed Monkeys. The Miocene period is blessed with the evolution of Primates, as revealed by the discovery of ancestral forms of Gibbon, Giant Apes of a generalised Chimpanzee-Gorilla type. The Pliocene or the last phase of the Tertiary period is evidenced by the development of primates. Some are of opinion that at that period earliest types of man had appeared. They support their views by the evidences of human workmanship present in a few artefacts of stone discovered from the layers belonging to that very period. But it is a matter of great controversy.

Quaternary epoch is characterised by the development of man from its simplest to complex types. This epoch is divided into two periods, Pleistocene and Holocene. The former period witnessed the ice ages four times. According to the Geologists, most portions of the Northern Hemisphere were covered by ice sheets during this period, which came down from the Polar North. With the retreat of the glaciation, the Pleistocene period closed and Holocene started. The climate, flora and fauna changed completely during that period and with the gradual development of man's bodily structure, his mental status also developed and different inventions and discoveries in day to day life led him towards the threshold of civilization.

Now let us discuss how man has originated from the Pre-human ancestors. In answering this question, we shall have to study the whole evolutionary tree of the Primates. It has been taken for granted that Anthropoid apes, Pre-hominians and

man originated from a common ancestral stock. But the particular stage at which the human family branched off from the common ancestral stock is a matter of great controversy among the scientists. It is probable that the anthropoid-humanoid stock began to differentiate as early as in the Oligocene times. This fact can be explained from the fossil remains of *Propliopithecus*, the first anthropoid ape, discovered at Fayum from the Lower Oligocene bed. The examination of the anatomical features of this particular fossil reveals that it is very primitive in character. It is believed that the gibbon has descended directly from this type of animal through an intermediary stage, the *Pliopithecus*, the fossils of which have been found from the Lower Pliocene of Germany. Therefore, we see that the separation of the gibbon line took place earlier. Then the anthropoid-humanoid stock began to split into several branchlets. It is expected that the orange branched off from the common ancestral stock before it differentiated into chimpanzee, gorilla and humanoid forms. The discovery of *Palaeosimia*, an Indian fossil, from the Middle Miocene deposit, supports this fact, for *Palaeosimia* is considered to be the direct progenitor of the oranges. According to Keith, the separation of the anthropoid and human stock took place in the Miocene period. After the separation, a few changes occurred in the bodily structures, both internal and external, in the humanoid groups, probably due to climatic and dietetic factors. The question of man's presence in the strict sense of the term, has been much discussed by different authorities at different times. The problem of the Tertiary man has not yet been solved as there is no proper evidence in favour of this, except a few eoliths. But these eoliths fail, in many respects, to establish the fact firmly that they are shaped by human hands. Considering this fact, Boule concludes, 'In all probability, there was no such thing as Tertiary Man properly so-called'.

During the Quaternary epoch various modifications took place in the human phylum which developed in different lines. The representative of many lines had lost in the different layers

of the earth for ever. The discovery of several fossil apes, pre-hominians and men, has helped us in various ways in reconstructing the past story of our life. Though the number of these fossils so far excavated are very few in comparison to the vastness of the problem, yet these jointly throw some light in understanding our darkest past life.

The discovery of the *Pithecanthropus* and *Sinanthropus* helps in filling up the great gaps between apes and men. Simian and human characteristics were blended in these fossils. From the lower beds of the Quaternary came the Heidelberg man whose lower jaw, which is the only evidence discovered, shows the mixtures of simian and human characteristics. The Neanderthal man who appeared during the Middle Pleistocene period narrowed the gulf between these two separate branches. The presence of the Swanscombe and Fontchevade skulls in the Middle Pleistocene deposits established the fact that the earliest *Homo sapiens* had also shown their faces at that time. Their evolution took place independently and parallel to the Neanderthals. Some authorities believe that *Homo neanderthalensis* and *Homo sapiens* evolved from a generalised type in which two types of characteristics were mixed up. But the discovery of the Moulin Quignon jaw and the Galley Hill skeleton from the Abbeville and Swanscombe gravels respectively indicates the greater antiquity of *Homo sapiens* than that of the Neanderthals.

### CRADLE LAND OF MANKIND

At the time of searching out the probable cradle of humanity, we feel that our present state of knowledge is very limited in comparison to the vastness of the problem itself. Palaeontological evidence is still unable to tell us, without any doubt, the exact place of human origin. Before going to show the honour of producing the supreme animal of the world to a particular country, we should consider the following facts.

It has been established by the Palaeontologists that human evolution did not take place in North America, where all primates vanished since the Eocene times. South America was also dominated by the Platyrrhine branch. It seems that these lands were not occupied by human being before the end of the glacial period.

Coming to Australia, we see that it cannot be responsible for producing mankind as we do not find here any native mammals except the Monotremes and the Marsupials.

Therefore, in searching out the cradle of mankind, we must cast our eyes towards the Old World. Though Europe presents some fossil primates and pre-hominians, yet these are not sufficient to give her the honour for originating man. The place of origin of the hominid is thought to be somewhere in Asia and Africa, as both these continents submit richer and reliable evidences than Europe. But the credit goes to Asia, in view of the facts that this continent is the abode of all main races of mankind. Most of the earliest fossil apes and men have been discovered from the soil of this continent. But at the same time, it should be kept in mind, that the claim of Africa can not be neglected completely, as it has also yielded many fossil and living apes. *Australopithecinae*, the most valuable remains in studying the evolutionary tree, is also the presentation of this continent.

Taking Asia as the land of man's origin, we now search out the particular region where men first evolved. The greater number and diverse characters in the fossil apes found in the Siwalik Hills during Upper Miocene and Lower Pliocene periods, reveals that in that particular region process of differentiation must have taken place. The discovery of some centres of well-developed primitive cultures also, more or less, supports this view.

The South Central Asia experienced some topographical changes during the Tertiary Era. At that time the Himalayas were not in existence. A great revolutionary change came in the animal kingdom due to sudden upheaval of the Himalayas

and the Tibetan plateau. The climate of the Central Asia was also changed. That change naturally brought some newness in the mode of life and nature of the animals inhabiting that particular area. At that time, it is probable, the complete separation between the Anthropoid ape and Pre-human stock had already taken place. The newly formed Himalayas divided the moist jungle of that area into two parts—Northern and Southern. The climate of the Southern part remained as usual, while the Northern part became dry, which resulted in steppe lands and deserts. The specialisation of man took place in the Northern region. The ancestors of the anthropoid, it is thought, emigrated towards the Siwalik Hills region, while the man's ancestor began to adopt themselves to the new environment of dry and steppe region. In due course, further differentiation took place and from where they travelled towards different directions.

Many evolutionists hesitate to believe the one-line human evolution. Somebody holds that the process of evolution was not restricted to a single continent. It took place in many lines and in different countries. Some of the scientists do not like to give Asia the proper honour for producing man through evolution. They accept the old view of Darwin, and said that it is Africa, but not Asia which can claim to be the cradle land of mankind. The discovery of the great Miocene Apes of Kenya and of the Australopithecinae from the African soil supports the view.

## 5

# SKELETAL PARTS OF MAN

*Instead of walking in bending attitude supported by the arms like other animals, man walks erect. The upright posture required a major shift in the body's center of gravity. What are the major changes that have undergone due to the new mode of locomotion? How a male skeleton can be differentiated from that of a female?*

## AN ELEMENTARY STUDY OF THE HUMAN SKELETON

The skeleton of man, whose function is to support the soft tissues and to give a definite form of the body, can be divided into three obvious parts—the SKULL, the TRUNK, and the EXTREMITIES.

### THE BONES OF THE SKULL

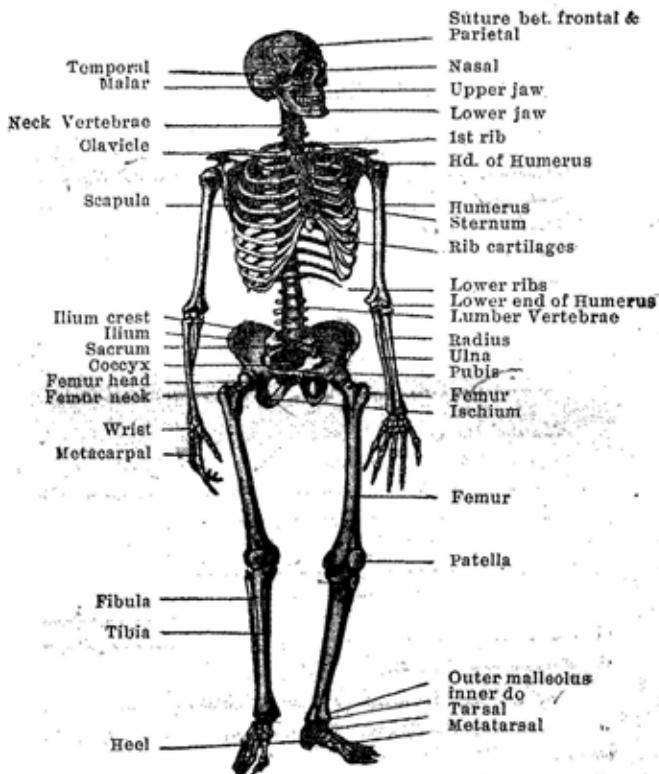
The skull is a large bony case which rests on the upper end of the vertebral column. It can be divided into two parts—the cranium and the face.

The cranium is more or less dome-shaped bony case which contains the brain. The cranium is formed by eight bones :—

*Frontal* (1)—It forms the forehead region.

*Parietal* (2)—The shape of these bones are quadrilateral ; they form the side walls and roof of the cranium.

*Occipital* (1)—It forms the back and part of the base of the skull.

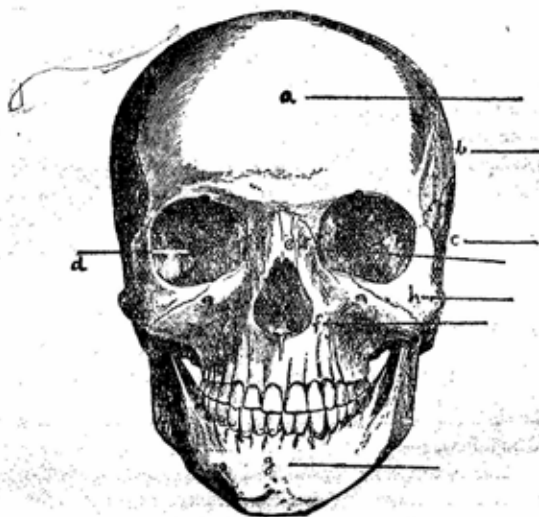


*Ethmoid* (1)—It is irregular in shape and placed at the anterior part of the base of the skull. It forms the lateral walls and roof of the nasal

cavity, the median walls of the orbit and the septum of the nose.

*Sphenoid* (1)—It is irregular bat-shaped and placed in front of the temporal bones and nasal portion of the occipital bone, at the skull base.

*Temporal* (2)—These are placed at the side and base of the skull.



(a) *frontal*, (b) *parietal*, (c) *temporal*, (d) *sphenoid*,  
(e) *nasal*, (f) *superior maxillary*, (g) *Inferior maxillary*,  
(h) *malar*.

The *face* forms the front and lower portion of cranium and consists of fourteen bones :—

*Superior maxillary* (2)—These form the upper jaw and the greater part of the palate. The upper set of teeth is fixed in them.



*Palatal* (2)—These form the back part of the palate.

*Malar* (2)—Each malar bone is situated in the upper and lateral parts of the face and it gives the prominence of the cheek.

*Nasal* (2)—These are a pair of small flat bones which bridge across the gap between the two maxillae and form the bridge of the nose.

*Turbinated* (2)—These are scroll-shaped bones of nose and placed horizontally in the lateral walls of the nasal cavity.

*Lachrymal* (2)—These are placed on the nasal side of the orbit.

*Vomer* (1)—It is quadrilateral in shape and is situated in the lower part of the septum of the nose.

*Inferior maxillary* (1)—The lower jaw—the largest and only movable bone of the face. The lower set of teeth is fixed in it. The mandible consists of two parts:—the body or the horizontal part, and the ramus or the broad flat bone which turns upwards and slightly backwards from the posterior end of the body. The junction of the ramus with the body of the mandible is known as the angle of the jaw.

## DIFFERENT VIEWS OF THE SKULL

The skull may be viewed from various angles which can be named as follows:—

- (1) *Norma verticalis* (view from above)
- (2) *Norma frontalis* (view from front)
- (3) *Norma occipitalis* (view from back)
- (4) *Norma basalis* (view from below)
- (5) *Norma lateralis* (view from side)

A systematic description of the various bones and sutures of the skull has been given below:—

### NORMA VERTICALIS

*The bones*:—(1) The Frontal (2) The two parietals (3) The occipital-squama of the occipital.

*The Sutures* :—(1) Coronal—lies between the frontal and two parietal bones, (2) Sagittal—situated between the two parietal bones, (3) Lambdoidal—lies between the occipital and two parietal bones.

### NORMA FRONTALIS

*The bones* :—(1) The frontal, forming the forehead, (2) The super-ciliary arch above the orbit, (3) The maxilla, (4) The nasal.

### APERTURES

(1) The orbit—Two in number and placed on each side of the nasal bones. These are conical cavities in which the eye-balls are placed. Each orbit is provided with medial and lateral walls, a roof, a floor, a base and an apex. At the inner and lower region of the orbit there is the upper opening of the lachrymal canal through which the tears rolled down.

(2) The supra-orbital foramen and infra-orbital foramen.

(3) *The Nasal aperture* :—

Placed below the orbits, and is bounded by the maxillae and the Nasal bones.

*The Sutures* :—

(1) Fronto-nasal, (2) Fronto-maxillary, (3) Fronto-zugal, (4) Infra-nasal, (5) Naso-maxillary. (6) Inter-maxillary, (7) Zygomatico-maxillary.

### NORMA OCCIPITALIS

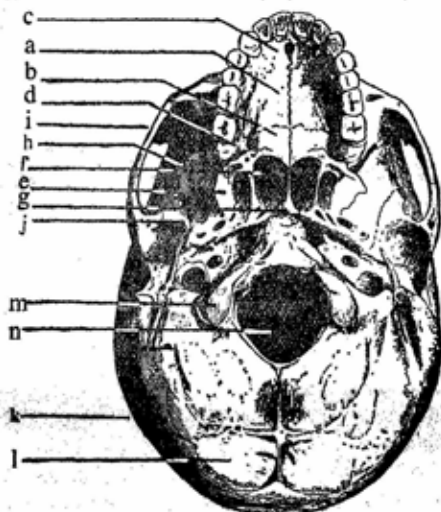
*The bone* :—Occipital. Its protuberance is most important which gives a convex outline.

*The Sutures*—(1) The occipito-mastoid, (2) The parieto-mastoid, (3) The lambdoid.

### NORMA BASALIS

At the basal region of the skull we find a number of smaller bones and foramen which have been summed up here. For the sake of convenience we may divide the basal portion of the skull into three different regions—the *anterior part*, formed by the palatine process of the maxilla and the horizontal plates

of the palatine bones; the *middle part*, from posterior to the first part upto the anterior margin of the foramen magnum; and the *posterior part*, formed by the rest portion of base of the skull.



(a), (b) and (c) *palatal*, (d) *lesser palatine foramina*, (e) *back opening of nostrils*, (f) *vomer*, (h) *temporal*, (i) *malar*, (j) *sphenoid*, (k) *parietal*, (l) *occipital*, (m) *occipital condyles*, (n) *foramen magnum*.

The following are the important features on these three parts of the *Norma basalis*—

(a) *The Anterior part* :—(1) Tubercle of the palatine bone, (2) Palatine crest, (3) Posterior nasal spine, (4) Alveolar process, (5) Incisive fossa, (6) Lateral incisive foramina, (7) Median incisive foramina, (8) Greater palatine foramina, (9) Lesser incisive foramina, (10) Intermaxillary suture, (11) Inter-palatine suture, (12) Palato-maxillary suture.

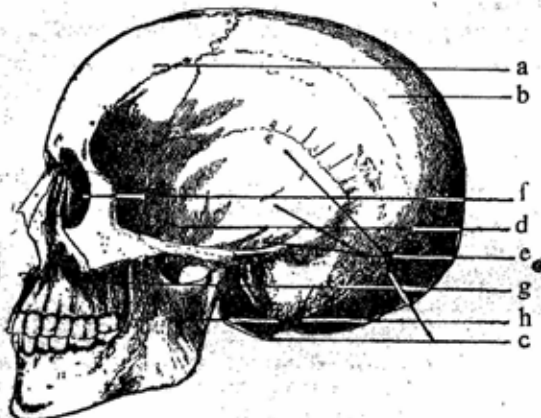
(b) *The middle part* : (1) Pharyngeal tubercle. (2) Tympanic part of the temporal bone. (3) Pterygoid process and pterygoid fossa. (4) Foramen ovale. (5) Foramen lacirum. (6) Foramen spinosum. (7) Carotid canal.

(c) *The posterior part* :—(1) Occipital condyle, (2) Styloid process, (3) Mastoid process, (4) Foramen magnum, (5) Condylar fossa, (6) Jugular foramen.

### NORMA LATERALIS

The following features are noticed here :—

(1) Temporal line, (2) Zygomatic arch, (3) Pterion, (4) Temporal fossa, (5) External auditory meatus, (6) Mastoid portion of the temporal bone, (7) Squama of the temporal, (8) Mastoid process, (9) Styloid process (10) Infra-temporal fossa, (11) Squamosal suture, (12) Spheno-



(a) *frontal*, (b) *parietal*, (c) *occipital*, (d) *wing of sphenoid*, (e) *temporal*, (f) *lacrimal*, (g) *superior maxillary*, (h) *ramus*.

frontal suture, (13) Zygomatico-temporal suture, (14) Spheno-temporal suture.

**THE TEETH.**—The teeth indicate many important features and, in man, these have undergone many significant changes. In man, there are two sets of teeth—deciduous or milk teeth, and permanent teeth. The former set is temporary and the eruption of which begins at the very infant stage and these are replaced gradually by the permanent set when the child becomes five or six years old.

The milk teeth are 20 in number and these are arranged both on the upper and the lower jaws like the following :

I 2/2, C 1/1, M 2/2.

The permanent teeth are 32 in number and are arranged as follows :

I 2/2, C 1/1, Pm 2/2, M 3/3.

On studying the anatomy of a tooth we find the following features :—

(1) **THE CROWN**—It is the portion of a tooth which projects beyond the gum. The crown is covered by hard white substance known as *enamel*.

(2) **THE ROOT**—It is the portion of a tooth which fits into the sockets.

(3) **THE NECK**—Between the crown and the root there is a slightly constricted region which is known as neck.

*Study of the different teeth :—*

(1) **THE INCISORS**—These are placed in front of the jaws and are used for cutting the food. The crown of the incisor is chisel-shaped. The root is single and straight.

(2) **THE CANINES**—These are placed after the incisors and are known as tearing teeth. These are large, and the crown is conical. The root is single.

(3) **PREMOLARS**—The premolars have more or less conical crowns, each of which possesses two cusps—an inner (lingual) and an outer (buccal). The root is generally single.

(4) **MOLARS**—These are popularly known as grinding teeth and have large dome-shaped crowns. The upper molars

possess four cusps each, and the lower molars have five cusps. Each molar is provided with three roots.

**THE HYOID**—It is a U-shaped bone placed in the ventral floor of the pharynx below the tongue base.

## THE BONES OF THE TRUNK

The trunk is composed of the vertebral column and the ribs with the sternum.

## THE VERTEBRAL COLUMN

The vertebral column is composed of a number of independent bones, the vertebrae, arranged one after another. The base of the skull rests on the uppermost or the first vertebra which is known as the *atlas*. The lower portion of the vertebral column is placed in between the hip bones.

The vertebral column is composed of thirty-three vertebrae. Each vertebra consists of a body and a vertebral arch. These two form a ring through which the spinal cord passes. Each ring is called *neural arch*. Of the thirty-three vertebrae, twenty-four are movable on each other, and the others are immovable. The movable vertebrae are called the *true vertebrae* and the rest are known as the *false or fixed vertebrae*.

The vertebrae, according to the position and nature, can be grouped like the following:—

**Cervical**—The vertebrae of the neck region, and these are seven in number. The body of the vertebra is small and the spinous process is short and bifid.

**Thoracic**—These are the vertebrae of the region of thorax and are twelve in number. The body is larger and the spinous process is long with thick lateral process.

**Lumbar**—These are the vertebrae of the lumbar region and are five in number. The body is large and massive, and the spinous process is thick and broad. The lateral process is long and slender.

*Sacral*—The five vertebrae of the pelvic region, sacral vertebrae, fused together to form a single wedge-shaped bone.

*Coccygeal*—The vertebrae of the tail region or the coccygeal vertebrae fused totally to form a small triangular bone—the coccyx. The number of vertebrae is usually four, but it may vary. The coccyx of man corresponds morphologically with the tail of other animals.

### THE RIBS

The thorax of man is like a cage in which there are certain important soft organs, such as, the heart, the lungs, and the great blood vessels. The greater part of the cage is composed of the ribs, which are 12 pairs in number. The ribs are curved bones, connected in pairs, with the dorsal vertebrae behind, and except the last two pairs, with the breast bone or sternum, in the front side.

The above seven pairs of ribs are connected by their own cartilages directly with the sternum, and they are known as *True ribs*. The cartilages of the next three pairs of ribs are joined each to the cartilage of the one immediately above. These are known as *False ribs*. The other two pairs of ribs are very short and their anterior ends are free, for which, they are known as *Floating ribs*.

### THE STERNUM

The sternum or the breast bone is a wide and flattened bone consisting of three separate parts. The first part is the longest and is known as the *manubrium*. The next part is called the *body*, while the last one, the *xiphoid* process.

### The Bones of the Extremities

The upper extremities consist of the following bones:—

- (a) The Pectoral Girdle or the shoulder, (b) the Upper arm, (c) the Forearm, (d) the Wrist, and (e) the Hand.

The Pectoral Girdle—Two in number, one on the left and

the other on the right side. Each pectoral girdle consists of two bones—the *Clavicle* and the *Scapula*.

*The Clavicle or the Collar-bone*—It is a long bone, stretching from the top of the sternum to the shoulder. One end of the clavicle articulates with the sternum and the other with the acromion process of the scapula.

*The Scapula or the Shoulder blade*—It is triangular in shape and is situated on the postero-lateral aspect of the chest wall. A prominent ridge is present on the back of the scapula which is known as *spine*. The scapula is attached to the outer end of the clavicle. At the upper and outer part of the scapula there is a cavity—the *Glenoid Cavity*—which articulates the humerus.

*The Upper arm*—The upper arm consists of a single bone known as the *humerus*. *The humerus* is long and strong bone; and consists of a long portion called shaft, and two enlarged ends—upper and lower. The upper end is large and rounded, which articulates with the glenoid cavity. The lower end broadens out transversely to form pulley-shaped surface, in order to articulate with the Radius and Ulna.

*The Forearm*—The forearm consists of two separate bones—the *Ulna* and the *Radius*.

*Ulna*—It is found on the inner side of the forearm. It has a shaft and two ends—upper and lower. The upper end is thick and exhibits a hinge joint which articulates with the lower end of the humerus. The lower end is slightly enlarged and it has a smooth articular surface and a prominent styloid process.

*Radius*—The radius is the lateral bone of the forearm. It has a disc-shaped upper end which articulates with the humerus and the ulna. The lower end has a medial and lateral articular surface to articulate with the wrist bones.

*The Wrist Bones*—The wrist or *Carpus* consists of 8 irregular-shaped bones arranged in two rows—the proximal and the distal. The proximal row is made up of the *scaphoid*,



*lunate, triquetral, and pisiform*, whereas the distal row consists of the *trapezium, trapezoid, capitate, and hamate*.

*The Hand*—The hand consists of the *Metacarpus* and *Phalanges*.

(i) *Metacarpus*—These are five in number. The metacarpus are long bones connecting fingers with the wrist. Each metacarpal has a shaft and two ends—proximal and distal. The distal end is provided with a large head.

(ii) *Phalanges*—The phalanges are three in number in each finger but the thumb possesses two. Each of them is provided with a shaft, a head and a base. In one hand, the total number of phalanges are fourteen in number.

The lower extremities consist of the following bones:—

(a) the Pelvic Girdle, (b) the Thigh, (c) the Patella, (d) the Leg, (e) the Ankle, and (f) the Foot.

(a) *Pelvic Girdle*—The pelvic girdle consists of two irregularly shaped bones—the *innominate bones*. The dorsal portion of these bones are articulated to the sacral vertebrae, and anterior ends curve around to meet together in the mid-ventral line—the *symphysis*, and thereby enclose an oval or circular pelvic cavity. Each innominate bone consists of the three fused parts—the *pubis*, the *ischium*, and the *ilium*. These three bones unite at the centre to form a cavity—the *acetabulum*—in which the head of the femur fits. The ilium and the ischium enclose a large foramen known as the *obturator foramen*.

*The Thigh*—The thigh bone is the largest and strongest bone of the body and is known as the *Femur*. The femur consists of a shaft and two ends. The upper end is provided with a large rounded head to articulate with the acetabulum. The head possesses a short neck. At the junction of the neck with the shaft, there are two trochanters—greater and lesser. At the posterior border of the shaft there is a rough ridge which is known as the *linea aspera*. The lower end articulates with the tibia and the fibula.

*The Patella or Knee-cap*—It is a flat triangular-shaped bone situated in front of the knee joint.

*The leg*—Each leg bone consists of two separate bones—the *Tibia* and the *Fibula*.

*Tibia*—The tibia is a large bone and it has a broad expanded horizontal upper end, a triangular shaft, and a slightly expanded lower end. The anterior border of the tibia forms a sharp crest which is called the '*Shin*'. The head of the *tibia* articulates with *fibula* and *femur*. The lower end articulates with *fibula* and *astragalus*. At the lateral border of the lower end there is a notch, called the *Fibular notch*. The tibia transmit the body weight from the femur to the foot.

*Fibula*—It is a very slender bone ; it has a shaft, and upper and lower ends. It is fixed to tibia at both ends.

*The Ankle*—The ankle consists of seven bones ( *Tarsus* ) in two rows. The proximal row is composed of the talus and the calcaneum, whereas in the distal row there are three cuneiforms and the cuboid ; the other, navicular, is found in between the talus and the medial three bones of the distal row.

*The Foot*—The foot consists of the *Metatarsus* and *Phalanges*.

(i) *Metatarsus*—These are five in number. Each metatarsal has a shaft, a head and a base. These connect the toes with the ankle.

(ii) *Phalanges*—The phalanges are three in number in each toe but the great toe presents only two. The phalanges of the toes are very small in comparison to those of the fingers.

## THE INFLUENCE OF ERECT POSTURE ON

### THE SKELETON OF MAN

Man principally differs from all other animals by his attainment of truly biped mode of locomotion. Instead of walking in bending attitude supported by the arms like other animals, man walks erect. The changes that have undergone in the

skeleton of man due to the fully erect posture are numerous. The important changes on the various parts of the skeleton are noted below.

### The Skull

The skull of man is well-balanced, unlike other animals, on the first vertebra or atlas. The foramen magnum or the large opening through which the spinal cord passes into the vertebral column is placed centrally at the basal aspect of the skull. With the well balancing of the head, the face becomes vertical.

### The Vertebral Column

When man stands erect, the head remains in natural equilibrium. But at that time the weight of the viscera in the abdominal and thoracic cavities tends to throw the trunk in the forward direction. In order to avoid this, two anatomical arrangements have been made in the human skeleton. The elastic ligaments that are interposed between vertebral laminae help the body to keep it in erect position. Secondly, the four alternative curves present in the vertebral column tend to preserve the line of gravity of the head and trunk in the axis of sustentation that passes through the pelvis. In this way, the weight of the head and trunk falls mainly on the pelvis, and the resultant weight which comes in line with the general direction of the column itself, and this condition has made the erect posture so easy.

The processes of the vertebrae have also undergone a few changes in their structure. With the natural equilibrium of the head the action of extensor muscles, spinal muscles and of the cervical ligament become less important which resulted in a complete change in the direction and size of the spinous processes of the vertebrae—and especially of the cervical region, which are directed downwards in man.

### The Thorax

The thorax is more developed transversely than that of the other mammals. The transverse diameter of the thorax is much greater than the dorso-ventral diameter. The flattened chest helps in throwing the centre of gravity of the body backward towards the spine.

### The Pelvis

The pelvis plays a great role in the erect posture of man and, naturally, it exhibits many changes. The pelvis is formed of two halves, each of which consists of three fused bones, the *ilium*, the *ischium* and the *pubis*. The flattened bases of the ischia form the bottom of the pelvis, known as the *haunch bones*, upon which the animals rests their weight while in sitting position.

When man stands erect the pelvis transmits the weight of the entire body with the exception of the lower limbs. As a result of this, the pelvis of man becomes flattened downward and expanded laterally ; it also becomes lower and broader.

After careful examination of the human pelvis, Schultz and Straus have come to the conclusion that the human pelvis is so greatly specialised that it is difficult to say that man has evolved from an ancestral stock of the chimpanzee-gorilla-orang type. They have seen the following main features in the human pelvis before passing their above remarks.

- (a) The human ilium is extremely short.
- (b) The excessive breadth of the sacral part of the human ilium.
- (c) The sacrum, in all other primates except man, articulates with the ilium at a place so far above the acetabulum that there is no fixed bony structure opposite to the pubic bones, as is found in man, in the form of the lower part of the sacrum.
- (d) The human pelvis exhibits much larger and thicker acetabular region than that of the other primates. It indicates

that the head of human femur is much larger than that of any other primate. In man, the acetabulum is found situated near the centre of the pelvis when seen from the side.

From the above study we find that the changes in the human pelvis do not indicate any form of ancestral modifications, rather these indicate that the changes have occurred due to the assumption of erect posture and bi-ped gait on the ground.

### The Limbs

Our adoption of erect posture is related very much to the remarkable nature of our limbs. The way we move about is really an excellent. In man, the arms are shorter than in apes and the legs are relatively very long. It may be said that in man the physique of the upright apes has been converted for walking.

The ridges for muscle attachments in femur are much more sharply defined and differentiated than in the anthropoid apes. The back side of the femur possesses a rough ridge known as the *linea aspera*, a characteristically human feature. It has resulted due to the great development of the extensor muscles which play a most important role in the erect posture and bi-ped gait. These muscles are also found in the apes but much less developed than in man. Due to the great development of this ridge the cross section of the human femur exhibits a prismatic form, while in apes it is round and oval.

The foot of man has witnessed remarkable changes due to the assumption of erect posture. When man's ancestors began to walk erect the function of the foot was completely changed from grasping to supporting which resulted in the following anatomical changes.

- (a) Loss of opposability of the great toes.
- (b) Development of the shock absorbing arch.
- (c) Tendency towards monodactyly.
- (d) The axis of the foot running through in between the first and the second toe.

- (e) Formation of the medial and lateral arches.
- (f) In the fifth digit reduction in the number of phalanges is in progress.
- (g) The calcaneum becomes larger.
- (h) Wedge-shaped development of the other tarsal bones.

The forearm of man is comparatively shorter than those of the anthropoid apes. The latter group have developed the longer forearm due to their practice of brachiating. Sir Arther Keith has explained that during locomotion the anthropoids grasp a branch and throw the body upward by flexing the arm. In this type of lever movement, the weight is suspended from the shoulder joint and the fulcrum is at the elbow joint. The power is applied to the upper arm which acts as the movable lever. But in the case of man, we find the different use of the arm. He applies it for lifting weights. At this time the fulcrum is at the elbow and the forearm which acts as the movable lever. In anthropoid apes, the arm is the movable lever and becomes short, whereas in man the forearm is the movable lever and is characterised by its shortness.

Another influence of brachiating is the elongation of the hand and specially the fingers and metacarpal bones. The thumb becomes less important and it is much shorter in comparison to the other fingers. In man, the hand is no longer an organ of locomotion and, therefore, it has become shorter in length. The metacarpals have become short.

From the above discussion, we see, that the use of the legs alone for walking, and of the arms alone for other purposes, has brought many significant changes in the skeletal structure of man.

### SEX DIFFERENCES IN HUMAN SKELETON.

In living human beings we can easily distinguish a male from a female. The influence of sexual characters is also seen in the skeleton also. The sex is probably determined at the time of fertilization of the ovum. In human foetus, the sex can

be distinguished as early as the seventh week. Therefore, we see that the sex differences are established in human being long before birth.

Certain parts of the human skeleton show prominent sex differences, and all these should be studied jointly in order to get a correct result. No single character of sex identification is to be relied on. Now let us discuss the prominent points of sex differences found on the skull, the thorax, the pelvis and on the sacrum of human skeleton.

### *THE SKULL*

(1) In males, the general size or vault and the face are larger than in females.

(2) The cranial capacity is about 150 c. c. to 200 c. c. greater in male skull.

(3) The thickness of the bones of male cranium is more than that of the female.

(4) The muscular impressions are more marked in males than in females. The supra-mastoid crest are very prominent in males.

(5) The forehead is more retreating in males. In female, it is vertical and rounded. The frontal eminences are well-developed in females.

(6) The superior borders of the orbit are blunt in the case of males and sharp in females.

(7) The supra-orbital ridges are more prominent in male than in female.

(8) Supra-mastoidal crest, mastoid process are larger in males. The zygomatic process of temporal border are more thick in males than in females. The zygomatic bone is stouter in male.

(9) The alveolar arches are higher in male and lower in female.

(10) The mandible of male presents greater size and thick-

ness, greater weight, higher body, higher symphysis, broader ramus and stronger condyles.

(11) The gonion angle of the female mandible exceeds  $125^{\circ}$ .

(12) The chin is square and forwardly projected in male; and in female the chin is pointed.

(13) The palate of the male is larger, broader and less higher than that of the female.

(14) The styloid processes are larger in male than in female.

(15) The bones of the skull are more rough in male, and in weight the male skull exceeds the female.

### *THE THORAX*

The thorax also presents certain sexual differences which should be considered at the time of sex determination. The female thorax differs from the male in the following features:

(1) Its capacity is less.

(2) The sternum is shorter.

(3) The upper ribs are more movable which allow a greater expansion of the upper part of the thorax.

### *THE PELVIS*

The pelvis shows more prominent sexual features than any other bones in the body. The female pelvis shows some special features. It is specially adapted to facilitate the passage of the foetal head during parturition and, therefore, it varies in structure with those of the males.

(1) The bones of the female pelvis are very delicate in comparison to those of the males.

(2) The ilia are more vertical and the anterior superior vertical iliac spines are further apart.

(3) The inlet of the pelvis is larger in the female and is more or less circular in outline, in the male it is heart-shaped.

(4) The cavity of the female pelvis is wider and shallower.



(5) The depth of the pubic symphysis is less and the distance between the two pubic tubercles is greater in the female.

(6) The sciatic notches are wider and shallower in female.

(7) The acetabulum are smaller in the female.

(8) The obturator foramen is small in the female and more or less triangular in shape. In male, it is almost oval.

### THE SACRUM

The sacrum also presents a few important sexual features which are noted below :

(1) The sacrum is shorter and wider in female than in male.

(2) In female, the pelvic surface of the bone faces more downwards than in the male. This increases the size of the pelvic cavity.

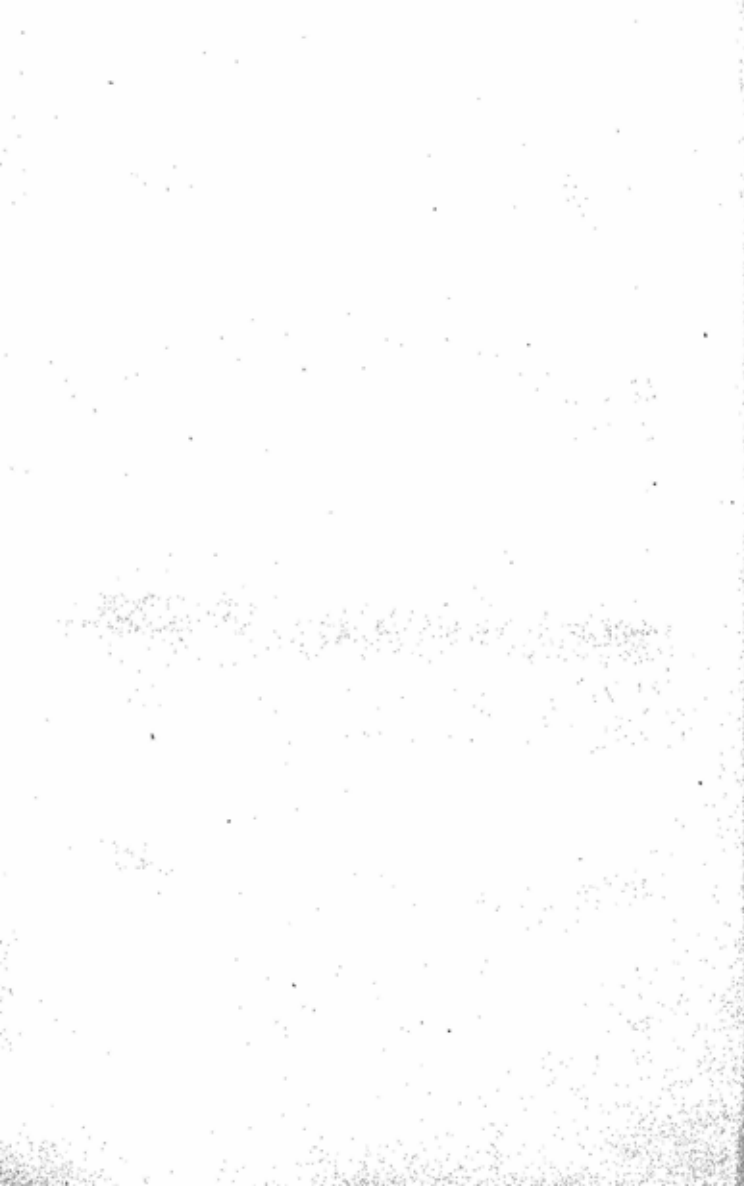
(3) The auricular surface for articulation with the ilium is shorter in female than in the male.

### Difficulties

In spite of all the above criteria for sex determination, sometimes we feel difficulty in sexing a skull or other parts with certainty. As for instance, we see that the frontal region of the skull of Negroids and the Mongoloids tends to be infantile in both the sexes. Among the Australoids the crania of females, most of the time, possess bigger brow-ridges and teeth than are found in white European males. Sometimes the adult bones do not exhibit any clear differentiation of the sexual characteristics or display contradictory features, which create much troubles in sexing the individual.

PART THREE

FOSSIL REMAINS



## FOSSIL MONKEYS AND APES

*Life is regarded as an endless thread. The evidence of the pageant of life is found everywhere. It is largely obtained by the careful and scientific study of the rocks and fossils. What do the rocks say regarding the fossilised monkeys and apes?*

The history begins with written records. But if we want to study the story of the period without any trace of writing we must, in that case, take the help of the unwritten evidences of nature. It has already been said that the different strata of earth can be compared with the pages of a book. In these larger pages of nature, are written the story of our remote past by means of fossilised remains. These natural writings are no less genuine, and these are the only way to reach into the darkest chapter of our life. What is the fossil? Naturally, the question comes to our mind. The fossils are the hard parts of animals or plants which have been infiltrated by mineral substances, present in the layers of the earth, and turned into stones. The term fossil has been derived from the Latin word *Fossilis*, which means to dig up. Therefore, in the strict sense of the term, the fossils mean many matters including foot-prints and other marking on the ancient rocks. But in studying Anthropology, we generally restrict the term to fossilised bones of animals and man.

## THE STRATIFIED ROCKS AND THE FOSSILS

The flowing water carries sand, mud and various other materials and deposit these in layers on the floor of the sea or lakes. The sand is the heaviest material, and it settles first, on the bottom to form sandstone in due course. Then the mud comes down and after sometime, it becomes hardened which is known as shale. The remains of different animals also deposit with these and form limestone. This accumulation of slowly deposited layers or strata, is known as the sedimentary or stratified rocks. In the stratified rocks the lower layers are more ancient than the upper ones. The fossil remains of different animals are found in the layers of these rocks. The geologists have been able to arrange the stratified rocks of the world in a series, according to their age. From their examination it has also been possible to find out the correct estimate of the age of different strata, and, therefore, we get an idea about the chronology of the different animals found fossilised in the different strata.

The stratum of the stratified rocks does not present us the remains of an animal to study its anatomical characters only, but it also lets us know something more. When we discover a fossil man from any stratum, we get, side by side, many other valuable evidences such as, remains of other animals and plants, stone implements and other works of man, which help us in studying the climatic conditions and culture of that period.

In the following pages we shall take up the case of some of the important fossil primates, and in a way of discussion we will find out their evolutionary significance.

### Lemuroids

The fossil lemurs have been found from the lower Eocene deposit onwards in the soils of both the New and the Old World. The fossil lemuroids are represented by a family *Adapidae*, which is divided into two sub-families, the *Adapinae*

and the *Notharctinae*. The former is found in Europe and it is represented by three distinct genera, *Adapis*, *Anchomomys* and *Pronycticebus*, while the latter represents one European genus *Protoadapis* and two American genera, *Notharctus* and *Pelycodon*.

The size of the *Adapis* is small and more or less look like the modern lemur. The difference between the *Adapis* and the modern lemur are that the former possesses a strong sagittal ridge, and in each jaw, there are four premolars instead of three as in modern lemurs. The brain also shows some primitive features and is smaller than the modern lemurs.

It is said that the lemurs disappeared from Europe and America, with the Upper Eocene or the beginning of Oligocene period. Sometime in the past, they entered into Asia and Africa, and especially into Madagascar, where various differentiation took place in the lemuroid stem. Some attained giant size with a small brain, which are known as the *Megaladapis*, whereas others, e.g. *Archaeolemur* and *Hadropithecus*, secured large brain box and short muzzles and thereby they had gone farther from the normal lemuroid type.

### Tarsioids

The fossil tarsioids have been found in the Eocene beds of Europe and North America. The size of these animals is not bigger than that of the mouse. The antiquity of tarsiers roughly approximates that of lemurs. But, on the whole, the lemurs show more primitive features than the tarsiers. The latter exhibit much more reduced snout as compared to the lemur. The tarsier has a large brain in relation to its face. It possesses larger orbits which indicate the nocturnal habit. It practically fills up the gap between the lemurs and the true monkeys. The reduction of snout is also a characteristic feature found in these animals which is no doubt a progressive trait.

The fossil tarsiers belong to one family and about twenty genera. The oldest of these is *Tetonius* (formerly *Anaptomorphus*) *homunculus*. This animal possesses rounded skull

and voluminous brain, for which, Cope has described it as a common ancestor of the monkeys and man. The tarsiers began to disappear from Europe and North America at the end of the Eocene times.

### Parapithecus

The Eocene and Oligocene deposits at Fayum in Egypt, are regarded as the palaeontological treasures. These have yielded many fossilised remains of animals, at various stages of evolution and thereby, have created much sensation among the students of evolutionary studies. In the year 1910, Schlosser discovered the remains of several primates at Fayum and he published a detailed account regarding all the remains.

The *Parapithecus* is a fossil primate known only from the lower jaw and teeth discovered from the Lower Oligocene bed at Fayum. The *Parapithecus* is a small primate about the size of a squirrel monkey and, therefore, it exhibits smaller body than any existing catarrhine species. The jaw of *Parapithecus* resembles that of the Tarsiers. There is no prominence of chin. The teeth show some primitive features. The canines are small and these do not project beyond the level of the neighbouring teeth. The grinding teeth are low-cusped. The premolars resemble those of the tarsiers of Eocene times. The dental formula is  $I\ 2/2, C\ 1/1, Pm\ 2/2, M\ 3/3$ . The face of the *Parapithecus* is short and the cranium is broad.

The *Parapithecus* is regarded as the most primitive of all known Old World apes and monkeys. According to Schlosser, it represents an evolutionary stage from which all the higher primates, apes and man, had been derived.

### Propliopithecus

The *Propliopithecus* is represented by fossil jaw fragments discovered from the Lower Oligocene bed at Fayum. Some opine that the *Propliopithecus* belong to the same age as the *Parapithecus*, but, after comparative analysis of the physical

features of the jaws of these two animals, it has been found that the *Propliopithecus* is much advanced.

The *Propliopithecus* is regarded as the ancestor of the *Pliopithecus* found in the Pliocene period and, for this reason, it has been named as the *Propliopithecus*. It is said that the gibbons of Malaya Archipalego are the direct descendants of the *Pliopithecus* of the Pliocene times. Therefore, the *Propliopithecus* can be called as the remote ancestor of the modern gibbons.

*Propliopithecus*, the first anthropoid ape, is said to have descended from a catarrhine monkey type much like *Parapithecus*. The jaw of *Propliopithecus* was shorter and deeper than those of modern gibbons and the canines were not larger. The average height of the *Propliopithecus* was not more than 20 or 21 inches.

#### ***Pliopithecus***

*Pliopithecus antiquus* was discovered by Lartet, in the year 1837, from the Lower Pliocene bed in Germany. It was represented by an incomplete lower jaw. It has already been said that the *pliopithecus* is closely related to the gibbons and it is a direct descendant of the Egyptian *Propliopithecus*. In this ancestral gibbon the jaw is deeper than that of the modern gibbons.

#### ***Lemnopithecus***

This has been discovered by Hopwood in the Miocene deposit from Kenya. This particular fossil exhibits certain resemblances with the gibbon regarding the physical features. It is thought that, like *Pliopithecus*, this apes has been evolved from *Propliopithecus*.

#### ***Proconsul***

*Proconsul africanus* was represented by a crushed palate and part of the facial region of an adult, a juvenile mandible, a, more or less, complete adult mandible, and three tarsal bones. These were found in the Miocene deposit in Kenya, East Africa.



The remains of *Proconsul* were first discovered by Hopwood and then by Leaky who considered this to be the direct ancestor of the chimpanzee and, that was why, they called it *Proconsul*, after *Consul*—a chimpanzee of the London Zoo.

The adult lower jaw of the *Proconsul* is marked by the absence of simian shelf, the reduction in size of the premolars, and the humanoid form of the mandibular condyle. The tarsal bones suggest that *Proconsul* did not move in the trees like the modern apes. The upper jaw is distorted and, therefore, it is impossible to determine the nature of prognathism. The canine is massive and projecting. These lightly built and active Miocene apes seem to have been nearer to the main stem from which man had evolved.

### *DRYOPITHECUS*

In the year 1856, Lartet discovered from the Miocene deposits, in South France, a lower jaw bone which was assigned to the genus *Dryopithecus*. Lartet and Gaudny jointly declared that the *Dryopithecus* was more closely related to the man and that had resulted in a great discussion amongst the scientists. But later in 1890, after the discovery of a complete lower jaw bone of the same type of animal, Gaudny opined that it was inferior to the living Anthropoids as regards evolutionary significance. Various fragmentary evidences of *Dryopithecus* have been discovered from the soils of Europe, Africa and also of India. There are about 12 different species of *Dryopithecus* so far discovered.

The place of *Dryopithecus* in the evolutionary stem has been found out by studying the peculiar dentition—the '*Dryopithecus* pattern'—which is characterised by five-cusped lower molars. The dental character of *Dryopithecus* was carefully studied by Drs. Gregory and Hellman. The grinding teeth resemble those of the chimpanzee and gorilla, so far as the pattern is concerned. An arm and a leg bone have been discovered which suggest that *Dryopithecus* possesses shorter arms and longer legs in comparison to those of the

modern apes. It is for this reason, *Dryopithecus* is said to have acquired the middle position between the apes and man. According to Gregory and others, the *Dryopithecus* is the common ancestor of modern man and apes. The different types of dentition of the different species of *Dryopithecus* also exhibit an evolutionary trend. Some *Dryopithecus* are closely related to the gorilla, while some show a tendency towards the orang and chimpanzee, as regards the dental characters. It is suggested that the *Australopithecus*, another giant ape, also evolved from one variety of *Dryopithecus*, but due to certain adverse situations, the *Australopithecus* could not evolve further. After careful studies of the different species of *Dryopithecus* it has been decided by many scientists that *Dryopithecus fontani*, *Dryopithecus rheanus* and *Dryopithecus darwini*, were probably the ancestors of gorilla, chimpanzee and the humanoid forms respectively. The difference in physical features among the basic races of man was probably due to the fact that two or more *Dryopithecus* species adopted humanoid characteristics.

### FOSSIL MONKEYS FROM THE SIWALIK HILLS REGION

The Siwalik Hills of Northern India is most important for the fossil fauna. These have attracted many palaeontologists from the different countries at different times. Lydekker and Pilgrim have studied the various fossil fauna, which included Dog-Faced Monkeys, Short-Tailed Baboons, Macaques and *Cercopithecus*. Several Anthropoid Apes belonging to the Miocene period were also their subject of study.

Pilgrim discovered in the Siwalik Hills an European genus of *Dryopithecus*. Another genus, *Palaeosimia*, was also discovered, which belonged to the Middle Miocene period. It is considered to be the direct ancestor of the present orang utan. In no case, it can be called as the ancestral to man because we find that the orang utan line differentiated from the main evolutionary stem much earlier than the gorilla and chimpanzee.

The genus *Sivapithecus*, discovered by Pilgrim, is a most

interesting fossil find. Pilgrim called this fossil ape to be in direct line with man on the basis that the lower jaw and back molars of this animal were human in characters. But the view of Pilgrim had been criticised by many scientists. Prof. Gregory remarked that characteristics of *Sivapithecus* resembled more the *Dryopithecus* and the orang than man. The other discovery of *Sivapithecus* from the same site was made by Pilgrim, a few days later. At that time it had been seen that the well preserved palate of *Sivapithecus* looked like that of chimpanzee. After that several fossilised fragments were discovered by Lewis which showed many human features and these fragments were known by the name, *Bramapithecus*, *Ramapithecus* and *Sugriapithecus*.

The above fossil fauna discovered from the different layers of Siwalik Hills are much valuable to the students of Palaeontology as these show many peculiar morphological characters, which indicate an evolutionary significance.

### THE AUSTRALOPITHECINAE.

A group of African fossils has attracted the attention of the scientists as links between man and apes. They are collectively called as Australopithecinae. They are also known as 'Dartians', after their discoverer Prof. Dart. The name *Australopithecus* has no relationship with Australia; *Australo* means *Southern*. The important members of this group are being described below in detail.

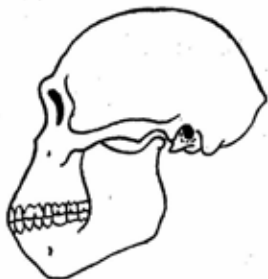
### AUSTRALOPITHECUS AFRICANUS

#### (The Taungs Ape.)

This specimen is represented by a Juvenile skull discovered at Taungs, South Africa, by Prof. Dart in the year 1925. The fossil remain discovered include the entire facial region of the base of the skull, together with a natural endocranial cast of limestone. The skull possessed twenty milk teeth and four permanent first molars. The possessor of this skull was probably five years old at the time of death.

The geological age of this fossil ape is very uncertain. But now it has been established that the geological age of the *Australopithecus* should be the Lower or Middle Pleistocene.

The Taungs skull was carefully studied by Prof. Dart who considered this to be in the direct line of descent of man. But this view has not received by many scientists. The skull resembles closely that of the chimpanzee in size and facial portion. *Australopithecus* is dolichocephalic. The supra-orbital ridges are absent. The orbits are circular like those of the orang and lemuroids. The premaxilla is well-marked



The Skull of *Australopithecus*

as is found among the apes. The nasal aperture is small and almost as high as it is wide. In man it is higher than its width, and in ape it is wider than its height. The face is slightly prognathous. The teeth are arranged on the jaw in human fashion. The canines are small and not tusk-like as in apes. The grinding teeth resemble the human in their every detail. The *Australopithecus* chewed their food just like us and the motion was not up and down as we find in the case of the apes. The diastema is found in the upper jaw between the incisor and canine. The palate is parabolic in shape which is a human feature.

The lower jaw is massive and thick. It resembles that of the chimpanzee and orangs. The chin is absent. The foramen magnum is situated further forward than in apes. This indicates that the head of *Australopithecus* is more well-balanced than in apes. The cranial capacity, according to Prof. Dart, is 520 c.c. The range of cranial cavity of the adult species has been estimated at 518-733 c.c. *Australopithecus* had larger brain than that of the chimpanzees and in many characters the brain showed humanoid features.

From the above study it has been cleared that *Australopithecus* exhibits the mixture of simian and human characters. It is true that *Australopithecus* is more manlike in character than any known anthropoid ape.

Let us now discuss the other members of this group and see the position of the *Australopithecinae* in the evolutionary tree.

### PLESIANTHROPUS TRANSVAALENSIS

In the year 1936, Dr. Broom discovered at Sterkfontein in Transvaal an almost complete skull, some teeth and skull fragments, which showed the characteristics allied to the Taungs specimen. The site where the skull was found was situated at a distance of more than 200 miles southwest of Taungs. At this time the fossil finds were also found in limestone deposits belonging to the Middle Pleistocene age. Dr. Broom first named it as *Australopithecus transvaalensis* and then *Plesianthropus transvaalensis*. Again, in the year 1947, Dr. Broom discovered several fragments of long bones, pelvis, etc. of the same species at a place situated not far from the earlier site.

The top of the skull of *Plesianthropus* lacked the bony crest as is found in the gorillas and orangs. The frontal sinuses are large. The face is concave in profile. The nasal bones are long with narrow nasal apertures. There is a slight alveolar prognathism. The molars are larger than those of chimpanzee or of man. The canines are slender and short. The

upper premolars of *Plesianthropus* resemble those of *Sinanthropus* in size. The two cusps of the upper premolars are equal in height—a human feature. In the case of the apes, it is seen that the outer cusp is much higher than the inner cusp. A diastema is noticed between the lateral incisors and canine. The palate is almost parabolic in shape as in man. The cranial capacity of *Plesianthropus* is estimated at 600 c.c.

### PARANTHROPUS ROBUSTUS

A bone remain of the fossil ape was discovered by a school boy who suddenly came across the piece of bone. The boy gave it to Dr. Broom who realised the importance of the bone and went to the site named Kromdraai, two miles east of Sterkfontein, and discovered from the Middle Miocene deposits several other bone remains. It includes a part of the skull, parts of humerus and ulna, some carpal and tarsal bones.

Broom estimates the cranial capacity of *Paranthropus* at 600 c.c. The face is marked by the forward projection of the cheek bones. The lower region of the upper jaw is flat. According to Gregory and Hellman, the lower facial region of *Paranthropus* resembles very much that of orang utan. The lower jaw is massive. The prognathism is noticed. The canines of *Paranthropus* are not well-preserved; the sockets for the canines prove that they were small in size. The molars have more humanoid tendencies. The palate is parabolic and not U-shaped as in apes.

The bones of the skeleton of the *Australopithecinae* exhibit many important features. The arms and the leg bones are typically human in every detail. Therefore, there is no doubt that the arms and legs of *Australopithecinae* resemble ours and they walked erect. In *Paranthropus* the occipital condyles were forwardly placed as in man, which indicate that the head was balanced for an upright posture. Dr. Broom also discovered three pieces of bones of the *Australopithecinae* skeleton which showed many human features. The first is the toe-joint bone of *Paranthropus*. It is mostly like that of man.

The second is the elbow end of humerus which resembles man in every detail. The third one is the knee joint of thigh bone of *Plesianthropus* which also shows many human features.

The pelvis shows many typical humanoid features. The shape of the ilium is like that of man. The thumb bones are definitely human. The long bones indicate the short stature of their possessors, who perhaps resembled the pigmies of human races.

On the whole, the *Australopithecinae* may be described as an animal, with man-like body, a head more ape-like than man, and massive jaws with human dentition. His upper extremity was smaller than the lower extremity and most probably he walked on two legs.

### Conclusion

Now it is a duty for us to place these South African fossil primates at a proper place in the evolutionary stem. We have already discussed the physical features of the *Australopithecinae* and now let us review the views of the different authorities regarding the place of these South African Man-Apes. One group of scientists holds that they are purely Anthropoids with a few human characters. According to Dart, Broom and Le Gros Clark, the *Australopithecinae* are definitely human. They possess certain humanoid characteristics which can only be explained by establishing a direct relationship with man. They say that if these South African fossils are not the direct ancestors of man, they must have been a collateral branch of the human stem. The third group believes that the *Australopithecinae* represents a stage in the process of human evolution, who disappeared before acquiring true humanoid forms. As regards brain development, the *Australopithecinae* show more tendency towards apes. According to Boule, the last *Australopithecinae* were contemporary with man. Gregory and Hellman do not consider it as the ancestor of man, and they call it as man's less evolved cousins.

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## FOSSIL PREHOMINIANS AND HOMINIANS

*All the living varieties of man belong to the single genus Homo sapiens. The gap from ape to Homo sapiens is filled with the early types of men whose fossilised remains are found in the different layers of the earth. How they look like and in how many characteristics they come nearer to or go far from modern man?*

### THE PREHOMINIANS FROM JAVA AND CHINA

[It is very difficult to trace the line drawn between man and non-man. Zoologically an animal can be called as man, when he takes bi-ped gait or at least develops an arch to his foot. The use of 'dressed tools' is also another characteristic of man. We have just finished the discussion about the Australopithecinae who have been regarded as the immediate ancestor of man by some scientists. But this view has been denied, and most of the authorities believe that discovery of the two important fossil finds from Java and China at different times caused a great sensation in the scientific world regarding their humanity. The discovery of these fossils threw a new light in the line of human evolution. Though these fossils show many primitive features yet in some cases they tend towards man. There are definite evidences about the erect posture of the possessors of these fossil remains. That is why



Dubois, the discoverer of the first find, gave the generic name as 'erectus' (walking erect). Somebody prefers to include the fossil finds of Java and Pekin in one group, and call them as *Homo erectus* in order to indicate a close relationship with our own species. However, it is beyond doubt that these two individuals exhibit many significant primitive features in addition to the human characteristics. For this reason, Boule prefers to call these individuals as Prehominians.

### THE JAVA MAN

#### *Pithecanthropus erectus*

In 1890-1891, a Dutch Doctor, Eugene Dubois, discovered a skull-cap, a thigh bone and two molar teeth of Java man, whom he named as the *Pithecanthropus erectus* (ape-man walking erect). This discovery was most sensational and brought revolution in the domain of natural science, and it was regarded as the long-sought transitional stage from ape to man. The deposits of these bone fragments occurred at a village named Trinil, situated on the bank of the river Solo. The layers from where the bone fragments of *Pithecanthropus erectus* were found, contained many fossilised plants and animals of different types. The fauna included two species of Rhinoceros, Hippopotamus, Stegodon and carnivores, cat-type and monkey-type.

The fossil finds of the Trinil river bed show a striking resemblance to that of the Siwalik Hills of India. Therefore, it is said that at that time there was a land connection between this island and the Asiatic continent. The geological age of *Pithecanthropus* finds are certainly Early Pleistocene, but some are of opinion that these belong to the Late Pliocene. According to Dr. Dubois, the *Pithecanthropus* layer undoubtedly correlates with that of the early Pleistocene.

Several discoveries have been made regarding the *Pithecanthropus* and its allied humanoid forms by different scientists in different times. The list of the various discoveries is given below :—

<i>Different Forms</i>	<i>Fragments obtained.</i>	<i>Discoverer</i>	<i>Place and time.</i>
1) Pithecanthropus I	Skull cap and thigh bone, and two molar teeth.	Dr. Dubois	Trinil (1891).
2) Pithecanthropus Mandible-A	Fragments of lower jaw.	Dr. Dubois	Kedung Brubus (1890).
3) Homo Modjokertensis	Juvenile skull cap and some facial parts.	Geological Survey	Near Modjokerto (East Java) 1916.
4) Pithecanthropus Mandible-B.	Lower jaw	Von Koenigswald	Sangiran (1936).
5) Pithecanthropus II.	Skull and some parts of lower jaw.	Von Koenigswald	Sangiran (1937).
6) Pithecanthropus III.	Juvenile skull fragments.	Von Koenigswald	Sangiran (1938).
7) Pithecanthropus IV,	Skull fragments and maxilla.	Von Koenigswald and Weidenreich.	Sangiran (1939).
8) <del>Meganthropus</del> Palaeo-javanicus (Female).	Mandible.	Von Koenigswald.	Sangiran (1939).
9) <del>Meganthropus</del> Palaeo-javanicus (Male).	Mandible	Von Koenigswald.	Sangiran (1941).

Now we shall study the *Pithecanthropus* finds in detail. In doing this, first of all, we should concentrate our attention in the Trinil remains because much work has been done with these. Besides the skull cap, two molar teeth and a femur found in Trinil. Dr. Dubois found a fragment of lower jaw, in the year 1890, at Kedung Brubus, thirty-five miles from Trinil.

### *The Skull-Cap*

The maximum length of the skull-cap is 184 mm. and maximum breadth is 134 mm. The cranial index is 70, and, therefore, the skull is dolichocephalic. The skull-cap



The Skull cap, Femur and Teeth of *Pithecanthropus*

shows simian characteristics in many respects. The cranial capacity of the skull is 850 c.c. In man, it ranges from

1000 c.e. to 1600 c.e. and in apes, it generally does not exceed 600 c.c. Therefore, regarding the cranial capacity of the skull, the *Pithecanthropus* falls between the apes and man.

The vault of the skull is low and almost like those of the apes. The bones of the skull are found to be fused and the sutures can not be distinguished. The supra-orbital ridges are continuous and fuse across the middle line forming a torus. This is found in gorilla and chimpanzee. The forehead is narrow and slanting. The frontal bone presents a slightly marked median keel. But the skull, as a whole, lacks any trace of sagittal crest as found among the anthropoids, such as the orang-utan and the gorilla. The temporal region of the skull is not very prominent and the temporal lines are widely separated, as in the gibbons, chimpanzee and man. The nuchal plane is more inclined than in the apes, and less inclined than in man. The outline of the skull shows a very flat contour as is found in the case of apes. Several anatomists have laid stress on the presence of an occipital crest which is always widely interrupted in men, even in primitive types. Taken as a whole, Dubois has said that the skull of *Pithecanthropus* may be compared to that of a gibbon, but much enlarged. The main characteristics of the Trinil skull place this in an intermediate stage between the chimpanzee and man of low status, such as Neanderthal man.

### *The Brain*

From the endocranial cast of the brain, it is evident that the frontal lobes of the brain are far smaller than those of modern man, though larger than those of modern apes. From the development of the certain parts of the brain, it is clear that *Pithecanthropus erectus* most probably had the power of speech. The parietal and post-parietal regions are more or less developed and this indicates the power of formation of thoughts and ideas. The interior frontal convolution is double than that of a chimpanzee and only half than that of a modern

man. Thus regarding the brain, it is clear that Pithecanthropus falls between the Great Apes and Man.

### *The Teeth*

The teeth found are three in number—a second upper left molar, a third upper right molar, and a second right lower pre-molar. These teeth are of enormous size. The roots of the teeth are widely separated as in apes. The crowns are more akin to human types. However, these teeth differ markedly both from those of man and from those of apes. Gregory is of opinion that these teeth resembles those of the orang and of the *Dryopithecus*. On the whole, it seems that the teeth of Pithecanthropus are more simian than human.

### *The Femur*

The femur of Pithecanthropus erectus is far more modern than his skull and teeth. The femur found is a complete one and measures 45.5 cm. in length, which indicates that the possessor of this femur is 165 to 170 cm. in height. The femur is straight, slender and long. A ridge is found on the femur, known as the *linea aspera*, on which powerful extensor muscles are attached which is essential for the upright posture of the individual concerned. The femur of Pithecanthropus shows an well-developed *linea aspera*, which suggests the erect posture. In its whole structure, the femur is so human that had it been found alone, there would have been no hesitation in attributing it a Pliocene man.

### *Discussion*

Some anthropologists are of opinion that the skull, the teeth and the femur found at Trinil belong to the different individuals. They said that the skull, the jaw-bone and teeth belong to an extinct giant anthropoid, whereas the femur belongs to a relatively modern man. But Dr. Dubois does not support this view. According to him, all fragments of the bones discovered belong to the same individual because no remains of primates have been ever discovered in Java,

except in this spot. It is beyond doubt that the bones belong to a single species, which had developed a human-like posture more rapidly than a human-like skull.



The Pithecanthropus skull reconstructed  
( After Weidenreich )

Pithecanthropus bone remains have been discussed by the different scientists in different times. This ape-like and, at the same time, humanoid primate has created a storm of controversy in the scientific world. According to many scientists including Dubois, Pithecanthropus represents an intermediate form between the anthropoid apes and man. But when Von Koenigswald, after studying the remains, disclosed that Pithecanthropus belonged to a very lower status, Dr. Dubois changed his opinion and began to think that the the Pihecanthropus was nothing but a gigantic ape related closely to the gibbon group. But the present state of knowledge suggests that this erect walking primate in his brain development and other characters, has surpassed any known fossil ape. In various characters it is more human than simian. Pithecatropus may not be our direct ancestor, but it certainly represents at least a collateral ancestor—'a great uncle, rather than a grandfather'

## THE PEKIN MAN

### *Sinanthropus pekinensis*

The discovery of *sinanthropus* is most important in the study of palaeontology. In the year 1921, Drs. Anderson and Zdansky discovered a few bone-remains from a village named Choukoutien, south-west of Peking in China. At that time, two molars were discovered and those were, in many respects, human in characteristics. Then Dr. Bohlin, in the year 1927, found the third molar which was examined and described by Prof. Davidson Black of Peking Union Medical College. Dr. Black declared that those belonged to the very earlier types of man, and further remains could be obtained by intensive excavations. From these findings he created a new genus, *Sinanthropus pekinensis*. In 1929, a Chinese Palaeontologist named, Dr. Pei discovered a notable complete brain-case of *Sinanthropus*. During the period ranging from 1928 to 1937, various fossil remains belonging to the *Sinanthropus* were unearthed and these were studied carefully by Dr. Black and F. Weidenreich.

The strata in which *Sinanthropus* skeletal remains have been discovered belong to the Lower Pleistocene to Middle Pleistocene. The fauna includes a primitive water buffalo, a big beaver, rhinoceros, hyenas, bears, rodents, etc. This fauna is completely different from that of the Loessic period. While the deposits were being dug up, Dr. Anderson had observed roughly worked pieces of quartz. Those were completely foreign to the said locality and their presence there could not be explained without thinking that those were brought there by man.

The *Sinanthropus* collection includes three incomplete brain cases, a dozen fragments of lower jaws, nearly fifty isolated teeth, a collar-bone, two fragments of long bones and four ungual phalanges. By 1939, the number of individuals in the *Sinanthropus* collection had risen to 38, of which 15 were children upto the age of 14 years.

*The skull*

The skulls of *Sinanthropus* are, in general, similar to those of the *Pithecanthropus*, but, in many respects, it is far advanced. The bones of the skull are very thick. The maximum length of *Sinanthropus* skulls range from 165 mm. to 205 mm. and an average of 194 mm. The maximum breadth of the skulls in question vary from 137 mm. to 143 mm. Both in length and breadth, the *Sinanthropus* skulls exceed those of the *Pithecanthropus*. The cranial index is 72.2 and, therefore, these are dolichocranial. The cranial capacity varies from 850 c.c. to 1800 c.c. with an average of 1075 c.c. The vault of the skull is high.

The forehead of the *Sinanthropus* is receding. On the frontal bone there is a bump which is lacking in *Pithecanthropus*. Supra-orbital ridge is of great size and comparable to *Pithecanthropus*. A ridge runs down the middle of the skull from front to back, known as the sagittal crest. The parietal bones are more or less flattened. The occipital torus is well-developed. The occipital bone slopes abruptly, while in man it is arching. The glenoid fossa for articulation with the jaw is comparatively deeper as in man.

The face of *Sinanthropus* is relatively small but projecting. It is broad in comparison to its length. The nasal bones are broader than those of modern man. The bridge is broad and high. The nasal spine is not present. The cheek bone is quite prominent and there is no oblique sloping in it as in European Neanderthal man. The upper jaw is not hollowed out as we find in the case of modern man. The malar bones are high and prominent as in modern Mongoloids. The orbits are large.

*The Brain*

The endocranial cast of the third skull shows a chimpanzee form. But the frontal lobes possess certain human characters.



Prof. Black opined that the hemispheres were slightly unequal.

The Sinanthropus people were right-handed and they could articulate language. F. Weidenreich marked the diminutiveness of the temporal lobe in Sinanthropus.

### *The Lower Jaw and Teeth*

Almost a dozen lower jawbones were discovered at Choukoutien. Prof. Weidenreich studied these fragmentary jaw bones systematically. The male mandible is very big and heavy, and these exceed in size and shape all the lower jaws of modern man. The female lower jaws fall within the range of modern Mongoloids. In its shape of the dental arcade the Sinanthropus mandible goes away from the Great Apes and comes closer to the Neanderthal man. Prof. Weidenreich has remarked that the Sinanthropus mandible presents a mixture of pithecoïd and human characters.

All the Sinanthropus teeth are large and robust than those of modern man. Their roots are longer and enamel is thicker. The teeth of the males are larger than those of the females. The incisors are shovel-shaped as found in apes, and also in certain human races, e.g. the Mongols. The upper canines are large and they rise above the level of the other teeth as Pithecanthropus and the Great Apes. But there is no diastema in these teeth. The pre-molars are ape-like in their oblique oval shape and in the development of a heel. The molars are low and long, whereas, in Hominids, these are high and short.

On the whole, the Sinanthropus jaws show more primitive human than simian characters.

### *Other Remains*

Only a very few skeletal fragments of Sinanthropus have been discovered, e.g. a semilunar bone, a large fragment of clavicle, two pieces of humerus, and seven femoral diaphyses.

Almost all these bones were badly damaged (except the semilunar bone).

The large fragment of clavicle was studied carefully by Prof. Black who found that it resembled the human collar bone in every detail. The semilunar bone also shows human features.

The femurs possess many interesting features. These are short and slightly bent. The femurs show marked front-to-back flattening that extends along their whole length. The curvature of the femur is slight and its summit is much closer to the lower extremity of the bone than in man.

#### *Discussion*

Prof. Black is of opinion that the Pekin man represents a stage higher than the Java man. But it is not far removed from the type from which the extinct Neanderthal group and modern groups of man evolved. Prof. Weidenreich found a peculiar hyperosteoses on the inner face of the lower jaw as is common in recent Chinese and Eskimo jaws. This fact has led Prof. Weidenreich to conclude that there is direct genetic relation between *Sinanthropus* and the Mongolian people. However, most of the anthropologists do not support this view.

Besides the presence of shaped stones along with the *Sinanthropus* skeletal remains, there were traces of charcoal, charred bones, which revealed that *Sinanthropus* people knew the use of fire.

*Sinanthropus and Cannibalism* : Prof. Weidenreich discovered a skull with five big wounds which were made to break open the skull. Almost all the skulls lack basal regions. Now the question comes who has done these? According to Prof. Weidenreich, these skulls had been broken by the *Sinanthropus* people themselves, who used to feast regularly on brains and bone marrow.

## Pithecanthropus and Sinanthropus.—Comparative Study.

### *Introduction*

The Java man, most famous and most discussed fossil, brought for the first time the problem of the coming of man before the public. The discovery of this particular fossil man created a storm of controversies in the then scientific world. No other discovery has ever made such a sensation among the people of various status.

The Pekin man may be called the second primitive species of great importance. The discovery of Pekin man did not create so much controversies as happened in the case of Pithecanthropus; rather the Pekin man was received with honour and understanding by the people.

### *Discovery*

In 1891, the Dutch Anthropologist, Dr. Dubois, found the first remains, a skull-cap, a thigh bone, and two-molar teeth of Java man, whom he named as the Pithecanthropus erectus. In 1936 and later, von Koenigswald and others discovered in the central region of the island of Java, the other remains of Java man.

The second type was discovered at Choukoutien, 37 miles south-west of Peking, in China. As early as 1922, and in 1927, the first find of the fossil 'hominid' teeth were discovered. Prof. Davidson Black examined those teeth keenly and established a new genus of man, Sinanthropus pekinensis. After this, various remains of Pekin man were unearthed by different scientists.

### *Geological Age*

These two early hominids—the Java man and the Pekin man—lived during the early Pleistocene age in Asia.

<i>Different Characters.</i>	<i>Pithecanthropus.</i>	<i>Sinanthropus.</i>
1) Size and form of the skull	Smaller in size, form is more or less same	Larger in size, form is same.
2) Cranial capacity	Average 860 c.c.	Average 1075 c.c.
3) Maximum length	Average 184 mm.	Average 194 mm.
4) Maximum breadth	Average 134 mm.	Ranges from 187 mm. to 143 mm.
5) Cranial index	70.0 Dolichoecranial	72.2 Dolichoecranial.
6) Vault	10.5 cm. ( Low )	11.5 ( High ).
7) Forehead	Receding; the frontal region is more or less flat.	Receding, the frontal region shows a bumplike development.
8) Median keel	Present	Present
9) Supra-orbital region	Heavy and continuous	Heavy and continuous. There is a distinct furrow which separates the forehead from the supra-orbital region.
10) Occipital region	Broad and rounded.	More or less, narrow and elongated.
11) Frontal sinus	It is large	It is very small
12) Palate	smooth	Rough
13) Lower jaw	Massive	Massive
14) Lower canines	Smaller	Larger
15) Molars	Larger in size	Smaller in size
16) Gap between the upper canines and lateral incisors	Present	Absent
17) Chin	Absent	Absent

In discussing the principal features of the skulls of Pithecanthropus and Sinanthropus, we see a close resemblance between them. The Java and the Pekin men belong almost to the same geological age in Asiatic continent. It is true that there are a few morphological differences between them, but these differences are not generic but specific in type. But a few characters like the ape-like gap between the lateral incisors, the primitive smooth form of the palate, the greater robustness of the frontal part of the mandible in Pithecanthropus, have made him more primitive than Sinanthropus. Dr. Dubois supports this view. According to him, the Sinanthropus is simply a primitive type of *Homo sapiens*. Prof. Weidenreich opines that Pithecanthropus and Sinanthropus occupy the same level on the line of human evolution. According to him, Pithecanthropus cannot be more primitive than Sinanthropus. He shows some dental characteristics of Sinanthropus which are more simian than we find in the case of Pithecanthropus. Weidenreich also tries to establish that modern man descends directly from the Sinanthropus-Pithecanthropus stage through the intermediate stage of Neanderthal man.



### THE MAUER JAW

#### *Homo heidelbergensis*

The knowledge of the Heidelberg man rests on one lower jaw which was discovered in the year 1907 by Schoetensack near a village named Mauer in Heidelberg. The Mauer sands are very rich in fossils. The associated fauna are the Ancient Elephant, the Etruscan Rhinoceros, Mosback, Red deer, Bears, Bisons, a sabre-toothed Tiger, Lion, etc. This fauna is most closely related to that of the lowest Pleistocene of France.

The geological, palaeontological and archaeological association proves that the lower jaw belonged to Pleistocene period. It is probable that the Heidelberg man flourished in the

Abbevillian cultural period. The discovery of this particular jaw is of great importance, since through this, we can come in contact with the Lower Palaeolithic man.

### Detailed Study

#### *The Lower Jaw*

The Mauer jaw is well-preserved. At the very first glance we are struck by its great size. It is large and massive; it gives an extraordinary powerful appearance. The ascending ramii are broad and low, and the chin is completely absent. These are all simian features.

The ramii are 60 mm. in breadth and 66 mm. in height and these give the mandible, when seen in profile, almost square form. The mandibular notch is not deep. The coracoid



The Heidelberg jaw

process is blunt, rounded, and at a lower level than the condyle. In these characters the Heidelberg jaw resembles that of the gibbon.

The horizontal ramii are high and massive. The lower border of the mandible is concave as is found in the case of the baboons, and unlike the apes and modern man. The symphysis is very thick and its external surface shows a convex and receding curve, which resembles the apes. There is no trace of

chin—another simian feature. The contour of the jaw as seen from above, is oval shaped, like that of human being and not narrow and oblong like that of the anthropoid ape.

### *Dentition*

The dentition of the Heidelberg jaw is definitely human. The alveolar border is parabolic in shape instead of the 'U'-shaped as is found among the apes. The teeth are well-preserved and these are smaller than those of the Neanderthal youth from Le Moustier. All the teeth are close together as in man. The absence of diastema in the Heidelberg jaw has given it a close human character.

The most notable feature of the Heidelberg find is the discrepancy in size between the teeth and large and massive mandible in which they are set. The teeth are of ordinary size. The incisors are normal with their roots slightly arched. The crown of the incisors does not rise above the level of the other teeth. In this point the Heidelberg closely resembles modern man.

The pre-molar are normal in size. The molars, too, are essentially human. These are almost as broad as long unlike those of the apes, which are longer than broad. In the cusp-pattern, the lower first molar shows a reduced fifth cusp, a primitive feature. But this feature is found among modern people, e. g. the Australian aborigines. The second true molar is the largest. The last molar or the wisdom teeth is slightly smaller than the second molar.

All the teeth of the Heidelberg jaw have large pulp-cavities. From the morphological character, it is clear that the blending of simian and human characters have been effected in the Mauer jaw.

### *Discussion*

The isolated Mauer jaw has caused much discussion in the scientific world. According to Schoetensack, this jaw exhibits many primitive features and in certain characters, it resembles the lower monkeys and even the

lemurs. Therefore, it seems that it has retained some characteristics of the common ancestors through which the apes and man have passed. But, on the other hand, it also shows many human characters, which are not found in most of the fossil men found in that period.

Considering these facts, some people regard the Heidelberg man as pre-Neanderthal type, who are probably ancestral to the Neanderthal man. But others are of opinion, that the Heidelberg man and the Neanderthal man are quite different ~~form~~ <sup>from</sup> each other and the former cannot be the ancestor of the latter.

### THE RHODESIAN MAN

#### *Homo rhodesiensis*

In 1921, during the mining operation at Broken Hill, Northern Rhodesia, Mr. T. Zwigelaar unearthed some bone remains. These remains were found at the extreme end of a long cave and consisted of a skull, lacking the lower jaw; a portion of the upper jaw of a somewhat smaller skull; a sacrum; fragments of pelvis and portions of femora and of tibia. Along with these bone remains some stone and bone implements were also found. The bones of the animals that have been discovered are belong to the species that still inhabit in Rhodesia.

The exact geological age to which the Rhodesian man belongs is not definitely known, but by inference it has been decided as early Pleistocene or later Pliocene.

#### Detailed study :

##### *The skull*

It is totally different in physical features from those of the South African types, but, in a few cases, it resembles the Early European Palaeolithic people—especially the Neanderthals.

The skull is long and narrow; the maximum length and



breadth are 206 mm. and 145 mm. respectively. It is, therefore, dolichocephalic. The height of the vault is 130 mm. In these points the Rhodesian man resembles the man from La Chapelle-aux-Saints. The cranial capacity, according to Dubois is estimated at 1400 c.c., whereas Elliot Smith has measured it as 1200 c.c.

The supra-orbital ridges are prominent than in Neanderthal man and the torus exceeds that of the gorilla in form. The forehead is receding and it is much lower and narrower than in Neanderthal specimens. The occiput is flattened as is found in the case of the Australians. The mastoid processes are well-developed and quite different from the Neanderthaloids.

The face is remarkably long and it greatly resembles the Neanderthal man. It has the large flat maxillary bones which lack canine fossae. The face exhibits a muzzle-like appearance. The orbits are very high and the cheek bones are strongly developed. The nasal bones are extremely long and broad. The nasal aperture is wide and it merges insensibly into the face as is found in the case of the gorilla.

The palate is large, wide and deep; in dimensions it exceeds that of the Neanderthal man. The teeth show modern human characteristics; the size of the canine is normal. The wisdom teeth are reduced in size and this condition is common among the civilized people of today.

#### *The long bones etc.*

The long bones exhibit no special characters. The sacrum is human. The femur and the tibia are different in physical features from those of the Neanderthal man. But they show many human characteristics.

#### *Discussion*

The Rhodesian man resembles the Neanderthal man in various characters. The skull base of the Rhodesian man exhibits a more advanced character than the Neanderthaloids.

In the skull of Rhodesian man, the *foramen magnum* occupies a more forward and more central position than the Neanderthal man. Therefore, the head of the Rhodesian man was well-balanced as in modern man. Considering this point, Woodward gave this man a specific name, *Homo rhodesiensis*. But Pycraft severely objected to this, who pointed out that the posture of the Rhodesian man was not erect. He said that the pelvis found along with the skull did not indicate the erect gait of the possessor. Pycraft had been criticised by Von Boninis who opined that the skull, pelvis, femur and tibia, all supposed that the possessor of those walked erect.

According to Prof. Boule, the Neanderthal man, Rhodesian man and the modern Australians have a common origin. Rhodesian man may be the African variety of Neanderthals. Prof. Boule thinks that the Neanderthal man must have spread throughout the length and breadth of the world. After the retreat of the Fourth Glaciation, the Neanderthal man disappeared from the soil of Europe. But it may be true that they may have continued their living in other regions. Same is the case with the Rhodesian man who has continued to live in Africa and has changed, in course of time, some of its primitive features, and thereby, he has gone further than his ancient European brother.

But Prof. Hooton holds a quite opposite view. According to his opinion, there is no sufficient likeness between the Neanderthal and Rhodesian man as to regard the latter as the variant of the former. He also points out that in some features, the Rhodesian man is inferior to the Neanderthaloids and even to *Pithecanthropus*.

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## MAN OF THE MIDDLE PALAEO-LITHIC PERIOD.

*The Neanderthal man—the only representative of the Middle Palaeolithic period—lived in caves that protected them from the severe cold during the period of glaciation. They had to struggle with the wild animals in their every step of life, and had to invent various means for the successful hunt. The Neanderthal folk made better stone tools than those of the preceding period which reflect the socio-economic life and activities of the period mentioned. What do the skeletal remains and tools say regarding the physical and cultural features of the men of the Middle Palaeolithic period?*

### THE CLIMATE AND CULTURE OF THE PERIOD

The hazy and dim picture of human life became much clearer in the Middle Palaeolithic Period which corresponds to the Mousterian cultural phase. This period differs greatly from the preceding one as regards geological, palaeontological and archaeological characters. Towards the end of the Lower Palaeolithic Period, the climate began to cool down and the continued lowering of temperature, resulted in the advance of Wurm glaciation. The climate became too cold, and being unable to bear the rigours of the severe cold outside, human life retreated into the cave. The chief animals of this period

were the large extinct species of mammals, the Mammoth, the Woolly Rhinoceros, the Cave-lion, etc. All these animals were provided with a thick coat of fur.

The human species that flourished in that period was the Neanderthal race. Physically the Neanderthal man possessed some apish characteristics. They walked with shuffling gait and probably could not hold their heads erect. The heavy brow-ridges, retreating forehead and chinless jaws gave their faces a peculiar feature. They could talk to some extent but that must have been very halting.

Mousterian culture was the only way of life of the Neanderthal people. The name Mousterian has been derived from the type station Le Moustier in the Dordogne, France. The characteristic Mousterian implements were made from flakes of flint, finished by chipping along the edges of one face only. The typical implements were the scrapers and the points.

The Neanderthal people were cave-dwellers. They were able to kindle fire as evidenced by the presence of hearths and charred bones inside the caves. The Mousterian cultural phase was based on hunting-fishing-gathering economy. In that dark and terrible phase of life, the Neanderthal man could form larger social unit for economic ends, because the killing or trapping a big animal like Mammoth required joint expedition.

These prehistoric peoples' devotion to the disposal of the dead is very remarkable. In this regard, the Neanderthal man had progressed much. They buried the dead bodies of their relatives and also provided them with tools, weapons and food. Various graves with Neanderthal skeletal remains have been discovered from the different parts of Europe. Certainly these men of the Mousterian period simply imagined some sort of life after death in the other world, where the dead would require food and implements. Most of the graves were found just beside the hearths as the dead had been allowed to warm his body. In that colder period man had definitely understood

the relation between the life and warmth, from which they might have come to the conclusion that warm was a cause of life. From these burial practices we get an idea about the religious concepts of the Middle Palaeolithic man

### THE NEANDERTHAL MAN

#### *Homo neanderthalensis*

A skull cap and some long bones were discovered from a valley known as Neanderthal, in Germany, in the year 1856. Since then numerous fossil finds are being discovered from the different parts of the world which are attributed to the Neanderthal man. All these fossil remains bear certain common features and due to which these may be grouped as the Neanderthal race. Almost all the findings are incomplete. But amongst these we find a best preserved specimen known as La Chapelle-aux-Saint found in a small cave in the department of Correze, France.

The following is the list of some important discoveries relating to the Neanderthal man.

<i>Name</i>	<i>Materials obtained</i>	<i>Place &amp; date</i>
<b>FROM EUROPE</b>		
1. Neanderthal	A skull cap and some long bones.	Dusseldorf, Germany. 1856.
2. Ehringsdorf I	Two mandibles and fragmentary skeleton.	Weimer, Germany. 1914-16.
3. Ehringsdorf II	Skull fragments.	Weimer, Germany. 1925.
4. Steinheim	Skull without lower jaw.	Wurtemberg, Germany. 1933.
5. Gibraltar I	Skull without lower jaw.	Gibraltar. 1848.

<i>Name</i>	<i>Materials obtained</i>	<i>Place &amp; date</i>
6. Gibraltar II	Skull fragments.	Gibraltar 1926.
7. Karpina	Skeletal fragments of several individuals.	Croatia, Yugoslavia 1899-1905.
8. La-Chapelle-aux-Saints	Skeleton	Correze, France 1908.
9. Le Moustier	Skeleton	Dordogne, France 1908.
10. La Ferrassie	Skeleton of two adults and four children.	Dordogne, France 1909-21.
11. La Quina	Skeleton	Charente, France 1908-21.
12. Spy	Two skulls, fragmen- tary skeletons.	Namur, Belgium 1886.

*FROM ASIA*

- |               |  |                    |
|---------------|--|--------------------|
| 1. Galilee    | Skull fragments.                             | Palestine 1925.    |
| 2. Mt. Carmel | Skeletal fragments<br>of twelve individuals. | Palestine 1931-32. |
| 3. Baisun     | Skull  | Uzbekistan 1938.   |

*FROM AFRICA*

- |             |            |               |
|-------------|------------|---------------|
| 1. Tangiers | Upper jaw. | Morocco 1939. |
|-------------|------------|---------------|

Hooton has divided the Neanderthal people into two complete heads—the conservative and progressive. The conservative Neanderthals possess the classical Neanderthaloid features, whereas the progressive group show a few more special characters which give the group a closer relationship with the Neanthropic man. La Chapelle-aux-Saints, Le Moustier, Le Quina, etc. are the examples of the conservative group and Ehringsdorf, Steinheim, etc. are the members of the second group.

The La Chapelle skeleton is beautifully preserved. There-

fore, it would be better to describe this particular skeleton as a representative of the whole race.

The remains of La Chapelle skeleton were found by French expedition in 1908. These were found buried in a cave in the Correze district, France. The materials include a skull with lower jaw, a clavicle, two humeri, two incomplete radii, bones of hand, fragments of ilia, two femora, portions of tibiae, bones of foot, and a number of vertebrae and ribs.

The associated fauna includes the numerous species, the most characteristics of which are the woolly Rhinoceros, Cave Hyæna, Ibex, Extinct Bison, Reindeer, etc. The layer in question is rich in dressed flints—scrapers and points, the two main types of implements of the Mousterian culture.

#### *The skull*

The skull in general is very large and heavy. It is dolichocephal and, when seen from above, it appears remarkably uniform. The maximum length and breadth of the skull are 208 mm. and 155 mm. respectively. The cranial index is 74.5. The Neanderthal cranial index, in general, varies between 70-76. The cranial capacity is about 1600 c.c. One of the characteristic features of the Neanderthal skull is that of the size of the brain. The earlier



The Skull cap of Neanderthal man

fossil men like Pithecanthropus, Sinanthropus had a skull capacity between those of apes and men, but Neanderthal man surpassed all. The cranial capacity of Neanderthal is well above the average capacity of modern Englishmen.

The skull is much more elongated behind than the front, where the frontal bone recedes greatly. There is a protu-

berance on the occipital region and the whole skull gives the tendency of having been flattened down. The whole surface of the occipital bone is rough which indicates strong muscular impression.

The supra orbital ridges are immense and continuous forming a heavy rounded torus. The orbits are large and round. The malar region is inclined forward, which is the indication of a flat cheek. The upper jaw is prominent. It projects forward to some extent. The nose is very broad and short; the nasal aperture is large, wide and pyriform.

The temporal fossae are large, the temporal lines rise half-way up the side of the cranium. The forehead is receding. The projecting parietal eminences are placed further back. The vault of the skull is low and, therefore, it makes the skull flattened in shape.

The base of the skull presents many primitive features. The foramen magnum is situated further back than in modern man. The palate is large. The mastoid processes are very small. The glenoid fossae are very shallow. The post-glenoid process is large. The superior alveolar border is very deep and strong. The alveolar prognathism is absent.

### *The Brain*

The endocranial casts of the Neanderthal skull present some important features. The La Chapelle-aux-Saints possessed a long, broad and low brain. The left side is somewhat larger than the right side, which indicates the right-handedness. The pattern of the convolutions are simple. Boule opines that the brain of La Chapelle-aux-Saints presents many features like those of the microcephalic idiots and of anthropoid apes. The parietal lobes are larger. This indicates a greater sensory development. The temporal lobe is also well-developed. In the occipital lobes, the visual and visuo-psyche areas show important development. On the whole, the Neanderthal brain though presents many primitive features, yet it is more human.



*The Lower Jaw and Teeth*

A number of lower jaws have been unearthed. These are large and massive. The ramus is very wide and the sigmoid notch is very hollow. The chin is absent. The symphysis slopes more backward and inward as is found in the case of the apes. The genial tubercles have already developed which is a characteristic of the modern human races.

The dental arch is 'U'-shaped and it is intermediate in shape between that of modern man and that of the apes. The teeth present human characteristic in arrangement. But most of the European specimens show taurodont dentition like those of Heidelberg and Sinanthropus. The wear of the teeth indicates the backward and forward chewing habit, whereas the modern man is habituated in side-to-side chewing. The canines are not projected and these are set on the curve and not on the side of the arch.

*The long bones etc.*

The long bones are particularly stout and strong, which suggests powerful muscular development.

The vertebral column of the La Chapelle-aux-Saints was short and massive. The first vertebra presents the simian features. The vertebrae have long and almost horizontal spinal process very similar to those of the chimpanzee. The cervical vertebrae do not show the forward convexity which is found in modern man. The vertebrae of the other regions are poorly preserved. The lumbar curve in Neanderthal man was less pronounced and the sacrum was straight instead of being anteriorly concave as in modern man. It is certainly a simian feature. The ribs are strong which denote a broad thorax with very powerful intercostal muscles.

The clavicles are long, slender and larger than modern man. The proportions of the limbs are ultra-human, the forearm is very short in relation to the upper arm and not enormously elongated as we find in the case of the apes. The right

humerous is always a slight stronger than the left. The radius, instead of being straight as in modern man, is curved. Ulna does not show so much simian characters as we find in radius. The hand is very human in character but the carpal is relatively small and the fingers are comparatively short.

The pelvis is very short in relation to its breadth. The femur is massive, strongly bowed forward as in the apes, with a weakly developed *linea aspera*. They resemble the femora of the gorilla and chimpanzee. From this point, some authorities opined that Neanderthal man was less erect in posture than the *Pithecanthropus*. The tibiae are very strong and short. The upper head is sloped backward indicating Neanderthal man's movement with knees bent.

The Neanderthal foot exhibits some interesting features. The ankle bones possess some special characteristics. The astragalus is short and broad. The head is bent denoting a wide separation of the great toe from its neighbours. The calcaneum or heel bone also has certain peculiarities. On the whole, the foot, though human, retains a number of simian features.



Reconstruction of the La Chapelle-aux-Saints Skeletal remains.

(After Mac Curdy)

#### Stature

The stature of the La Chapelle-aux-Saints, as calculated by Boule, is 5 feet 1 inch. The statures of the classic Neanderthals vary between 5 feet 1 inch and 5 feet 5 inches.

### Neanderthal man and modern man

#### *A comparative analysis*

Now let us compare the physical characteristics of Neanderthal man with those of the modern man and see in how many ways the former is related to the latter.

#### *Differences :*

(1) In general, flattening of the skull of the Neanderthal man differs from the modern man and resembles the apes.

(2) The parietal-temporal suture is straight in case of the Neanderthal but it is arched in man.

(3) The zygomatic arches are more projecting as we find in the case of the apes.

(4) Mastoid process is not so developed as in man but it is small and rudimentary.

(5) The backward projecting occiput is traversed as a ridge from side to side in homologous with the occipital crest of the apes.

(6) The alveolar region does not merge with the nasal floor as in apes.

(7) The symphysis of the jaw slopes backward and inward as in apes.

(8) The foramen magnum is placed more backwardly than in modern man.

#### *Similarities :*

(1) The size of the face is large. The large brow ridge and the depression of the nose resemble the modern Australoids.

(2) Broad nasal bones and wide nasal apertures of the Neanderthals resemble the Negroes.

(3) The face below the orbit is flat instead of hollowed out; this feature is like the modern man.

(4) The upper alveolar border is very deep as we find in the case of the Negroes and the Australoids.

(5) There is no simian shelf in the mandible and there is small tubercles as in man.

(6) The dentition is certainly human.

(7) The proportions of the limbs are quite human. The forearms is short in relation to the upper arm and the leg is extremely short in relation to the thigh.

(8) The cranial capacity of Neanderthal varies between 1300-1600 c. c. and it falls within the range of modern man.

### ✓ PROGRESSIVE NEANDERTHALS

A few Neanderthal specimens have been discovered which exhibit certain special characteristics and, therefore, differ, in many features, from the conservative Neanderthal types, which have already been discussed. Hooton termed these specimens as Progressive Neanderthals and these include Ehringsdorf, Steinheim, Karpina, Mt. Carmel types of fossil men.

#### *The Ehringsdorf Fossils :*

In 1914, a human lower jaw was discovered from the soil of Ehringsdorf, a village near Weimar, in Germany. Schwalbe, a German scientist, called it as the *Weimar jaw*. Then in 1916, skeletal fragments of a child aged about ten years were unearthed from the same level.

Along with these bone-fragments were discovered a number of stone artefacts of the Mousterian type and associated fauna were rhinoceros, brown bear, horse, and elk. All these indicate that the layer in question dates back to the end of the last interglacial period.

The first jaw belongs to an adult individual. In it the absence of chin is striking and alveolar prognathism is noticed. The teeth are very much worn. There is no trace of diastema between the canine and the first premolar. But it should be noted that the crowns of the incisors have extended beyond the level of those of the premolars.

The child's jaw also exhibits the same characteristics but some are less marked. In this jaw the dental prognathism is not so marked. The canine does not rise above the level of other teeth.

The third discovery was made at Ehringsdorf in 1925 from the same level. The material consists of a fragmentary brain-case which, according to Weidenreich, belongs to an adult female. But Keith believes that this skull must belong to a young man of eighteen years. The possessor of this skull must have met an unnatural death, as there are a few evidences of severe blows in the frontal region. Probably the fractures were made to bring out the brain for eating. These people, like *Sinanthropus*, were addicted to cannibalism.

The bones of the skull are thin, and the vault is high unlike the conservative Neanderthals. The brow-ridges are massive and the forehead is high. The supra-orbital ridges are continuous and separated. The length and the breadth of the skull are 166 mm. and 145 mm. respectively. The cranial index is 74.0 (Dolichocephalic). The cranial capacity is 1480 c.c. which is the average of modern man. The other characters of the skull are like those of the conservative Neanderthals.

According to Weidenreich, Ehringsdorf man represents a transitional stage between Neanderthal man and modern man. Keith is of opinion that it is a special variety of the Neanderthals.

### *The Steinheim Skull*

This skull was discovered from a gravel-pit at Steinheim in Germany in the year 1938. The skull seems to have belonged to a young woman and it is long and narrow. The cranial index is 70.0. The cranial capacity is 1070 c.c. This skull presents Neanderthaloid appearance by its enormous supra-orbital ridges, breadth of the nose etc. The vault is lower than the other Neanderthal types. The other characters,

such as a lower degree of facial prognathism, presence of canine fossae, well-developed squamous portion of the temporal bone



The Steinheim skull.

( After Boule )

and reduction in size of the wisdom teeth have brought this skull nearer to the modern man.

#### *The Mount Carmel remains*

The Mount Carmel skeletons were discovered from two adjoining caves in Palestine. These layers have yielded Levallois-Mousterian culture. In 1931-32, as a result of joint scientific expedition of the American School of Prehistoric Research and the British School of Archaeology in Jerusalem, a few fossil finds were brought to light.

The first cave, Skuhl, offered fragmentary remains of at least ten individuals and also many isolated bone fragments. Tabun, the second cave produced the skeleton of an adult female and a mandible of an adult male and various bones and teeth.

The Mount Carmel men are tall and the women are short and medium. They have massive heads. The forehead are moderately full and the occiputs are projected slightly beyond the attachment of the neck. The brow ridges of Mount Carmel men have a tendency to separate. The faces are of moderate

length and orthognathus. There are no canine fossae. Unlike the typical Neanderthals, the Mount Carmel men had vaults with medium height or above. There is a tendency of development of jutting cheek bone in the Mount Carmel people. The chin is almost well-developed. The teeth are smaller in size than those of the typical Neanderthals. The ramii of the typical Neanderthal are very broad whereas in case of Palestine men, these vary in size. In size and form of the brain the Mount Carmel people show the tendency towards modern man.

## CONSERVATIVE AND PROGRESSIVE NEANDERTHALS

### A comparative analysis

Attempts have been made here to discuss the main physical characteristics of the conservative and the progressive Neanderthals in a comparative way. The skeletons from La Chapelle-aux-Saints and Skuhl caves have been taken into account as the representatives of the Conservative and the Progressive types respectively.

<i>Sl. No.</i>	<i>Characters</i>	<i>La Chapelle</i>	<i>Skuhl</i>
1. Stature		Short	Men are tall, women are medium to short.
2. Body built		Stocky	Medium
3. Face		Long and prognathus.	Medium to short, Orthognathus.
4. Vault of the skull		Low	Medium and above medium.
5. Occiput		More or less in line with the neck.	Projects slightly beyond the neck.
6. Supra-orbital ridges		Large and continuous.	Large and there is a tendency to separate in the middle.

<i>Sl. No.</i>	<i>Characters</i>	<i>La Chapelle</i>	<i>Skuhl</i>
7.	Cheek	Flat	Jutting
8.	Jaws	Deeper	Moderate depth
9.	Chin eminences	Absent or rudimentary.	Well-developed.
10.	Ramus	Broad	Vary in length.
11.	Teeth	Always large	Not always large.
12.	Cranial capacity	Average 1400 cc.	Skuhl—1518 c.c. to 1587 c.c. Tabun—1271 c.c. to 1350 c.c.
13.	Form of brain	Primitive	Advanced
14.	Femur	Lacks the true linea aspera.	True linea aspera.
15.	Legs	Short, imperfect for erect posture.	Long, and completely adopted for erect posture.

### *Discussion*

The Neanderthal man represents a new type in the human family and he is considered as a separate species within the genus *Homo*. Prof. Weidenreich and some other anthropologists are of opinion that Neanderthal men are the direct ancestors of modern man. The modern man evolved from the Neanderthals through a transitional stage of Progressive types, e. g. Mount Carmelites. But this theory has received severe criticism from different corners. Neanderthal man cannot be our direct ancestor. He is regarded as more than a cousin of modern man. His evolution took place quite separately and then was replaced by modern man. This idea can not be supported by the fact that the early Neanderthals are more like modern man than the later types. The modern men cannot be the descendants of the Neanderthals on the ground that completely evolved modernistic type of fossil men were



discovered in Western Europe from the layers earlier than those of containing Neanderthal remains. No gradual change can be traced from one type to another. Most of the scientists do not believe that the Progressive Neanderthals are in transition to modern man. *Homo sapiens* did not evolve through a Neanderthaloid stage. According to them, the progressive types are 'Neanderthaloid collateral or cousins of the ancestors' of the Cro-Magnon type and not their direct ancestors. Boule also has said that no modern human type can be called as a direct descendant of the Neanderthaloids.

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## THE EARLIEST TYPES OF HOMO SAPIENS

*The problem regarding the origin of Homo sapiens has become the most controversial issue. It has been found out that a type of palaeolithic man, closely related to the Homo sapiens as regards physical features, was in existence in Europe as far back as the Lower and Middle Pleistocene period. What were these men like and what was their relation to us ?*

Formerly it was suggested that all Lower and Middle Pleistocene forms of man were non-sapiens in type and probably they were the ancestors of modern men. On this ground the Cro-Magnon type of fossil men were believed to be the first species of Homo sapiens. But the discovery of a few fossil remains from the layers earlier than those of the Cro-Magnon and even of the Neanderthaloids rejects the earlier hypothesis. These fossil men, viz., Galley Hill, Swanscombe, London, and Fontchevade exhibit many Homo sapiens characteristics which in no way is explainable, if we do not suggest the theory of co-existence of the Homo sapiens and the Neanderthaloids. Naturally, this theory proves that in Europe the development of Homo sapiens was parallel to that of the Neanderthaloids. But it is a matter of great controversy. However, let us discuss in details the physical features of the different kinds of the above mentioned fossil men.

### The Galley Hill man

The Galley Hill man was discovered in the 100 ft. terrace of the Thames River near London. A Workman, while working in the gravels, found the Galley Hill skeleton about 8 ft. down in the ground. This terrace was laid down the second interglacial period and as a few implements of Chellean type were found there, it would be probable that the Galley Hill man appeared in the Second interglacial period. Some authorities strongly opposed the great antiquity of Galley Hill man. First of all, no expert was present at the time of discovery and there was every possibility that those amateurs who discovered the Galley Hill skeleton were misled. When the bones of the Galley Hill man were presented to the Geological Survey of London, Sir John Evans and Prof. Boyd Dawkins expressed doubts about their high antiquity. Recently, Oakley's 'Flourine Test' showed that the flourine content of the Galley Hill skeleton is similar to those of the modern skull found from the same region.

Galley Hill man shows many marked features of modern man. It is true that the bones of the skull are thicker in comparison to those of the modern man, but in other characters it resembles the man of present day. It has a capacity of 1400 c.c., a high forehead with modern brow ridges. The head is long and narrow; the cephalic index is 69. The cast of the brain shows many modernised features. Face bones are not found; the mandible shows many primitive features, but the chin is well-developed. The ascending ramus has sigmoid notch in front of the condyle. The teeth are not large. The other bones of the skeleton exhibit many humanoid features. From these facts some authorities believe that Galley Hill man represent a primitive variety of *Homo sapiens*.

### ✓The Swanscombe man

The Swanscombe man is represented by a left parietal and occipital bones discovered at Swanscombe in Kent, England. The great authenticity of Swanscombe man

has been admitted by the Geologists. A few Acheulean type of implements were associated with Swanscombe man and the fauna included with these finds were *Elephas antiquus* and *Rhinoceros mercki*. From these facts it is clear that Swanscombe man belongs to the Middle pleistocene and probably to the second interglacial.

Morant and Le Gros Clark have studied the Swanscombe skull and they have declared that this must have belonged to a woman of about twenty years. This skull presents many features, which resemble the modern English female skulls. The cranial capacity—1325 c. c.—also shows similarity with those of modern skull. Except for the great thickness of the bones and the exceptional width of the squamous part of the occipital bone, this skull falls in line with the modern skull.

### The London Skull

The London skull is represented by a fragmentary brain box discovered in the City of London. At the time of digging the foundations under 'Lloyds', one occipital bone, a left parietal and fragmentary right parietal bones were found at nearly 38 feet below.

The London skull, also known as 'Lloyds' skull' or 'Lady of Lloyds', most probably belonged to a woman of fifty years. From the age of the deposit it has been seen that the London skull must have belonged to the Upper Pleistocene. The cranial capacity is estimated at 1250 c. c. which resembles the modern man. In other characters also the London skull resembles the modern human types.

### The Fontchevade Man

In 1947, Mlle G. Henri-Martin discovered some bone remains in a cave at Fontchevade. The finds consist of two individuals accompanied by Pre-Mousterian implements and fauna. After examination of the layers Henri-Martin realised that all the materials lay beneath a thick

layer of stalagmite on which there were many evidences of cultural remains ranging upwards from Mousterian to Magdalenian. The archaeologists and the palaeontologists place this fossil, with no hesitation, in the Pre-Mousterian period.

The bony remains, discovered at Fontchevade, consist of two brain-cases—one complete and the other fragmentary. These resemble the modern man in shape and size ; their thick-



The Fontchevade skull, seen from above.

ness are greater than those of the Neanderthaloid group. The complete skull is dolichocephalic, and in various characters it shows the similarities with modern man. The second skull is markable for its modern forehead and the complete absence of supra-orbital ridges. The cranial capacity is estimated at 1450 c. c. which resembles the modern man. Both of the skulls show clear humanoid features.

The above findings collectively indicate the Pre-Neanderthal occurrence of *Homo sapiens* in the soil of Europe. Prof.

Boule prefers to call these as *Pre Sapiens* because of their close similarities with *Homo sapiens*. Under these circumstances, it can easily be said that *Homo sapiens* was contemporaneous with or earlier than the Neanderthaloids, who acquired a remarkable degree of specialization and then disappeared. The case of the Fontchevade man can not be explained scientifically if we do not accept the fact of differentiation of *Homo sapiens* as early as the Pliocene. But it is a great problem and also a challenge to us. The theory of Pre-Mousterian occurrence of *Homo sapiens* should be established with great care. The evidences, so far we have received, in favour of the present theory are not sufficient and we need more remains to support the fact of existence of *Homo sapiens* in the Pre-Mousterian days. But it is clear from these facts that our evolution did not follow a single line and it took place in a very complicated way. At this present state of knowledge, we are unable to say anything more regarding the problem of Pre-sapiens, which may be solved some day in future, by new discoveries in this line.

## THE REINDEER AGE AND THE NEOANTHROPIC MEN

*With the retreat of the Fourth Glaciation, modern men came into existence in large numbers throughout the world. Homo sapiens of the period in question were, not necessarily, a uniform and homogenous type ; rather they exhibited a wide diversity of forms. What was the sequence and what were the relationships of the different varieties of fossil men to each other and also to the men of present day ?*

### THE CLIMATE AND CULTURE OF THE PERIOD

A great change in the climatic condition of Western Europe occurred just after the Middle Palaeolithic period. The cold climate was replaced by temperate condition in the Upper Pleistocene which corresponds to the Upper Palaeolithic according to Prehistoric archaeology. The Upper Palaeolithic culture is thought to have begun just from the closing phase of the Wurm glaciation and continued upto the end of the Pleistocene period. The fauna, flora and artefacts are very different, in this period, from those of the Lower Palaeolithic. Woolly mammoth and rhinoceros were found no more and the Reindeer came to this place. In this cultural phase Reindeer appeared in abundance and they played a great role in the material and economic life of man of the period in question. Due to this fact this period has been termed as the *Reindeer Age*.

A great progress is noticed in the upper Palaeolithic industry. The outstanding feature in the Upper Palaeolithic industry is the use of horn, bone and ivory besides stones as materials for making weapons and implements. The archaeologists on the basis of different fashion of making use of these materials have divided the Reindeer Age into three successive stages—Aurignacian, Solutrean and Magdalenian.

A new species of human race with graceful body, quite straight gait, straight forehead and finer head appeared in the scene. They lived in caves and rock-shelters; hunting and



Upper Palaeolithic art

fishing were their main economy. But their weapons for hunting were very beautifully made and worked with many skillful techniques. The Upper Palaeolithic people with higher intellectual development and brain capacity left many



evidences of their skill, their inventive genius and their artistic and religious activities in their dwelling places. They had a better taste for personal adornment. The teeth of wild animals, shells, etc. were used to make different kinds of ornaments. Their artistic activities are really praiseworthy. The walls of their caves were decorated with the representations of different animals. Some of them were engraved and some were painted with one or more colours. The artistic power reached a high order of excellence and most of them show the real aesthetic sense, masterly realism, unique execution. Some authorities believe that there is a magico-religious significance in these prehistoric arts, which is commonly found among primitive people even to day. The culture of the Reindeer Age people exhibits many striking similarities with the ways of life of some African tribes. The Bushman rock-paintings of South Africa bear many resemblances with those of the people of the Reindeer Age.

#### *Sub divisions*

As has been said earlier, the Upper Palaeolithic industry is divided into three stages—Aurignacian, Solutrean and Magdalenian that are arranged chronologically from the earliest to the latest.

*Aurignacian Stage* : It is so named after its celebrated type station of the Grotto de Aurignac. The most important feature of this cultural stage is the appearance of horn, bone and ivory materials, although flint is still chief material used for shaping tools. Elongated flakes become very frequent and are carefully retouched on their edges. The Aurignacian bone implements are of various forms ; the most characteristic one is a point with forked base. Some of these implements bear markings which appear as unskilled attempts at design.

*Solutrean Stage* : This is named after a village, Solutre, near Maco, Saône-et-Loire. This stage is marked by a neat and careful work in stone. Leaf-shaped flint points—willow leaf and laurel leaf—are the finest of all palaeolithic imple-

ments. These implements are characterised by a scaly retouch. Bone-working was little practised.

*Magdalenian Stage*: The Magdalenian stage is so named after the rock shelter of La Madeleine in France. This industry surpassed all the previous stages by working in bone and horn. The characteristic weapons are the barbed Reindeer bone and stag horn harpoons with single or double row of barbs, different kinds of spear throwers which were beautifully curved with figures of animals. These spear throwers have some resemblances with wooden spear throwers used by the Australian aborigines, the Eskimos in recent times. Most notable among the bone implements are the *batons de commandement*—the long and often decoratively carved pieces of reindeer antler with perforations which are still used by the modern Eskimos as arrow straighteners. The flint implements became less important in this stage. The artistic activities reached the highest level of excellence during the Magdalenian cultural stage.

### ✓ THE GRIMALDI MAN

In 1901, Prof. Verneau discovered two skeletons in the cave known as Grotte des Enfants, in Grimaldi village. The human skeletons discovered during this excavation work, lay at three different levels. From the lower level were found two skeletons—one belonging to a woman and the other to a boy of fifteen to seventeen years of age. They were buried side by side with their lower limbs much bent. The skeleton of the latter was painted with red ochre and its skull was protected by a sort of cist. A few ornaments made of bone, shells were found along with these skeletons. The cave deposits belonged to pleistocene period. From the bone remains of Reindeer, it was also clear that the Grimaldi man belonged to the Reindeer Age. The associated artefacts were of Aurignacian type.

Now we will discuss the physical characteristics of such a human type who, according to Prof. Verneau, exhibits many Negroid features, which have been detailed below.

**Detailed Study :**

*The Skulls*

The skulls are large and very elongated. These are hyperdolichocephalic; the cranial indices of the female and of the male skulls are 68.5 and 69.2 respectively. The skulls are very high, the cranial capacity of the boy is 1580 c. c. and that of the old woman is 1375 c. c. The mastoid processes are small. The regions of the parietal bosses are flattened.

The forehead is straight and well-developed; it is bulging to some extent. The supra-orbital ridges are feebly developed. The orbits are large and rectangular. The face is broad and not high. The nose is very broad and it is depressed at the root. The nasal aperture is wide, and in width and form of



The skull of Grimaldi youth

the lower border, it resembles the Negroes. The canine fossae are deep and it is a Negroid character. The upper maxillary projects forward. The palatal arch is very deep. The alveolar border is 'U'-shaped, which resembles the Negroes and the Australians. The jaw is very strong and the ascending branches are broad and low. The chin is little developed and there is a marked alveolar prognathism (Negroid feature).

*The Teeth*

The teeth are large and prominent. The teeth of the boy attract the attention in their unusual size. In many features these teeth resemble the Australian aborigines. The dental arches are less widely divergent unlike the modern races. The upper molars possess four well-developed cusps, whereas in the case of modern man these are three-cusps. All the lower molars have five distinct cusps unlike the modern races.

On the whole, the major characters of the skull and face show Negroid affinities.

*The Long Bones, etc.*

In proportion of the limbs, the Grimaldi skeletons show Negroid features. The forearm and the leg are very long in relation to the upper arm and thigh respectively. The shaft of the femur is strongly bent which suggests that the Grimaldi lady had not attained the perfect erect posture. According to some, the femur had become bent due to the old age, but we find that the Grimaldi woman was not very old.

Prof. Verneau, who has studied the Grimaldi skeleton in details, has remarked that in narrow sciatic notch, in the curve of the iliac crest, and in the vertical direction of the haunch bones, the Grimaldi lady resembles the Negroes. The radius is flattened. The tibia shows retroversion to some extent. The heels are well-developed. The estimated statures of the lady and the boy are 5 feet 3 inches and 5 feet 1½ inches respectively.

*Discussion*

The Grimaldi man shows some characteristic features which are readily comparable to the modern types and specially to the Negroes. Prof. Boule has stated that in physical features the Grimaldi Negroids resemble strikingly the Bushmen and the Hottentots. In addition to the physical features, e. g. dolichocephalic head, the alveolar prognathism, the flattening

of the nose, great size of the teeth, the Grimaldi Negroids have some affinities in cultural features with the South African tribes. Prof. Sollas also supports this view.



The skeletons of youth and woman, from Grotte des Enfants, France (*After Verneau*)

The Negroid character of the Grimaldi man has been accepted by many in earlier times, but its appearance in the soil of Europe has brought much controversies. It has been said by some, that Grimaldi and Cro-Magnon differ from each other in a few characters and, therefore, they should be placed

in two different racial groups. But Prof. Verneau has stated that there is no reason behind the establishment of the two racial groups for Grimaldi and Cro-Magnon, as the careful examination reveals a close relationship between the two. He has also declared that the Grimaldi Negroids may have been the ancestors of the later Cro-Magnon hunters of the Reindeer Age. Sir G. Elliot Smith and Sir Arthur Keith carried on independent research work on the Grimaldi skeleton and both of them came to the conclusion that the Grimaldi people had no special characteristics of the Negro group, but it merely represent the primitive example of Cro-Magnon stock.

### ✓ THE CRO-MAGNON MAN

The name has been derived from the village Cro-Magnon in the Dordogne region of Southern France where, in the year 1868, a few workmen of the Railway unearthed the remains of five human skeletons associated with dressed flints and great quantities of sea-shells. On getting the information M. Louis Lartet, a renowned geologist, went to the said site and continued the excavation work scientifically. Those skeletons were studied first by Broca and Pruner-Bey, and later by De Quatrefages and Hamy and named as Cro-Magnon Race. After this various discoveries were also made at different regions of Europe.

The geological age of these fossil finds is late Pleistocene period and later than the Grimaldi Negroids. The associated implements are those that have flourished in the Aurignacian stage of the Upper Palaeolithic period. The implements are characterised by better finish and wonderful drawings. Different excellent artistic activities such as, cave-paintings, stone and ivory statuettes are also the characteristic features of this period.

While discussing the characteristic physical features of the Cro-Magnon race, we should take up the 'Old Man of Cro-Magnon', which is the typical skeleton of this group.

## Detailed Study

*The Skull*

The skull is large. The length and breadth of the skull are 203 mm. and 150 mm. respectively. The vault is low. The cranial index is 73.7 and it is dolichocephalic. The whole brain-box exhibits a pentagonal contour when seen from above. It has resulted due to the marked projection of the parietal bosses. The forehead is vertical. Supra-orbital ridges are low and wide. The occiput is bulging.

The face is flat and very broad. Thus here we see that the long and narrow head is associated with the broad and short face—a disharmonic type. The orbits are wide and rectangular in form. The cheek bones are strong and prominent. The nose is narrow and long. The nasal bones are high. The upper maxillary shows a somewhat marked prognathism. The roof of the palate is narrow and shallow.



Skulls from Grotte des Enfants, Menton, France.

The lower jaw is strong; the ramus is not wide and the sigmoid notch is of fair depth. The chin is prominent and there is a well-marked mental eminence. The teeth are large.

*The Long Bones, etc.*

The long bones suggest a great height which is 5 ft. 11.6 inches for males (according to Boule). The muscle imprints

are strongly marked on the surface of the bones. The leg and the forearm are long in comparison to the thigh and the upper arm respectively. Some suggest that it shows a Negrioid feature in limb proportion. In the femur the *linea aspera* is well-developed and it forms a prominent column. The most characteristic features of the Cro-Magnon limb bones are the flattening of the thigh bones, called platymeria, and the side-to-side flattening of the shin bones known as platynemia. The femora are strongly bowed.

On the whole, the Cro-Magnon people were characterised by tall and robust bodies with long arms and shins. The head was provided with a massive brain-case, with moderate brow-ridges and elevated forehead. The high and narrow nose and well-developed chin gave the face of Cro-Magnon a beautiful look.

#### *Discussion*

The Cro-Magnon did not die out in France with the end of the Quaternary period and they continued to survive upto the present day through the Neolithic period. According to Dr. Collignon the descendants of Cro-Magnon still survive today in various parts of France. Quatrefages and Hamy also have observed the existence of the Cro-Magnon descendants in Dalecarlia, Southern Sweden, who, form a special group known as 'Dal Race'. This type has also been found in the different parts of Germany, viz. Westphalia and Lower Hessen. In various physical characters these people resemble the Cro-Magnon race.

Broca has also observed the Cro-Magnon characteristics among the Basques, the Kabyles and the Guanches. Quatrefages and Hamy, and later on, Verneau, have declared that among the Guanches of the Canary Islands, the Cro-Magnon characteristics are well preserved. Verneau has also seen the cultural parallels between the Cro-Magnons and the Canary Islanders. But Prof. Hooton has strongly opposed this view. According to him, the common cultural traits of the Cro-Magnon and the Canary Islanders are very few so to



speak. The latter possess a stone industry far inferior to that of the Mousterians. The cranial disharmony—a characteristic feature of the Cro-Magnon may be seen in many peoples all over the world. Lastly, Hooton has remarked that it is unwise to derive the Canary Islanders from the Cro-Magnon stem. He has also objected to the term *Cro-Magnon race*, because it has been seen that some of the Cro-Magnon specimens are of gigantic stature, whereas some show medium or short stature. Some are dolichocephal, and others are mesocephal and brachycephal also. These variations in physical features oppose strongly in establishing the Cro-Magnon race; as race means a group of people having some identical physical characters that inherit from its common ancestors. On this ground, Hooton disagrees to the use of the term Cro-Magnon race.

Recently E. Fischer, with the help of Dr. D. J. Wolfel, has studied the relationship between the Cro-Magnon people and the Canary Islanders and has remarked that there is a clear evidence of the survival of the Cro-Magnon stock as a definite type. His experiments are based on various anatomical and genetical factors. As a result of comparative anthropometric studies based on twenty-seven skulls belonging to the Palaeolithic Europeans, G. M. Morant has come to the conclusion that these skulls resemble the modern dolichocephalic races of Western Europe and there is no doubt that the latter population are the descendants of the earlier.

*The Other Remains of Cro-Magnon Man*

The Cro-Magnon bone remains have been collected from the different parts of Europe. Beside the famous site at Cro-Magnon village, the skeletons were also found from Paviland in England; from Engis and Engihoul, in Belgium, and from Aurignac, La Madeleine, Solutre, Grenelle, etc. in France. The other skeletons and fragments from the Grotto du Placard, at Vilhonneur in Charente, from Les Hoteaux in the Ain, from Combe-Capelle in the Dordogne, from Brunn in Moravia, etc. are also important. These bony remains have been found in good state of preservation and most of them differ surprisingly.

from the Cro-Magnon proper. All of these specimens show somewhat heterogeneous characters. Some are of short stature and some show gigantic tallness. The skulls of some specimens are dolichocranial whereas others present meso-or brachycranial features. The differences in characters naturally create a great difficulty in studying them systematically. Boule has said that we should study the characteristics carefully and, in the long run, we shall see that there is no reason in grouping these specimens in different sub-heads. Because the common characteristics found among them are of more value than the differential characteristics. Judging from the osteological point of view, Prof. Boule has come to the conclusion that the typical Cro-Magnon represents a median type and the other specimens have appeared due to the variation of characters which have resulted by the varying geographical environment, and also by the racial inter-mixture.

### ✓ THE CHANCELADÉ MAN

The name is derived from a rock shelter near Chanceladé where the discovery was made on October 1, 1888. It was discovered by two archaeologists from Périgueux, named Feaux and Hardy. The skeleton lay on its left side with the left hand placed under the head and the right hand under the left side of the lower jaws. The legs were bent with the knees just touching the jaws. The body was powdered over with red ochre and as a result of which the bones and the surrounding earth became red. The posture that has already been discussed recalls the methods of burial of certain Peruvian mummies. A large number of primitive and modern people also practise this type of burial. The modern Eskimos are a typical example.

The layers, from where the Chanceladé man was discovered, belong to the Upper Palaeolithic age and these present the implements of the Magdalenian cultural stage. Abundant reindeer bones were found in these layers.

## Detailed Study

*The Skull*

The skull is long and narrow with a cranial index of 70.9. The vault of the head is high. The cranial capacity is estimated at 1710 c.c. and it exceeds the average of the modern skulls. The supra-orbital ridges are slightly developed. The somewhat bulging forehead rises almost vertically. The parietal bosses are very marked. The mastoid apophyses are well-developed.



The Skull of Chancelade man : views from front, side, and top.

The face is very broad and high. Thus, there is a harmonic relation between the skull and the face. The cheek bones are prominent and strongly developed and these give the face a flat appearance. The orbits are wide. The nose is long and narrow. There is no sub-nasal prognathism. The palate is of medium

width and elliptical in form. The lower jaw is narrow and strong and it has very broad ascending ramii. The chin is prominent. The molars are powerful; there is a peculiarity in the molar teeth which increase in size from the first to the third, whereas in modern man, the third molar is smaller than the other two.

*The Long Bones, etc.*

The strong and massive limb bones of the Chancelade man suggest that the man had a vigorous frame and strong muscular body. The upper limbs are longer unlike the modern Europeans. The femora is slightly bent. The *linea aspera* is also well-developed as in Cro-Magnon man forming a distinct column. The shaft of the tibia is flattened in a transverse direction, and it is slightly platycnemic. The foot is large. The first metatarsal in the foot is distinctly separated from the second toe and this resembles the Neanderthal man.

*Discussion*

In various characters the Chancelade man resembles the modern Eskimos who live in a wild state in the midst of snow of Labrador and Greenland. In a number of characters, such as, short stature, large, high and dolichocephalic head, prominent sagittal ridge, a very wide and very high face, rounded orbits, prominent cheek bones, narrow nasal apertures, powerful masticatory apparatus, etc. the Chancelade man lies in a closer relationship with the Eskimos. Besides the physical likeness between the Chancelade man and the Eskimos, there are some cultural similarities. After studying the habits, implements and the artistic activities of the modern Eskimos, some scientists like Testut, Sollas, Mortant and others have tried to establish a closer relationship between the Eskimos and the Chancelade man. But this theory of relationship has vehemently been opposed by A. Keith who has remarked that the Chancelade man differs in many respects from the Eskimos. The former possess the orbits which are

COMPARATIVE STUDY OF THE PRINCIPAL FEATURES ON THE SKULLS OF  
PITHECANTHROPUS, SINANTHROPUS AND CRO-MAGNON SPECIMENS

Types consulted	Pithecanthropus erectus	La Chapelle-aux-Saints <sub>1</sub>	Old Man of Cro-Magnon
<i>Year of discovery</i>	1890-91	1908	1868
<i>Place of discovery</i>	Trinil village, in the island of Java	Bouffia cave near the village of La Chapelle-aux-Saints, France.	Cro-Magnon village, Southern France.
<i>Geological period</i>	Upper Pliocene	Upper Pleistocene	Upper Pleistocene
<i>General features of the skull</i>			
<i>Remarkable feature</i>	An elevation on the sagittal suture looks like the ridge-pole of a roof.	The Skull is much elongated behind than in front.	The whole brain-box gives a pentagonal contour, when seen from above.
<i>Maximum length</i>	184 mm.	208 mm.	203 mm.
<i>Maximum breadth</i>	135 mm. <sub>2</sub>	155 mm.	150 mm.
<i>Vault of the skull</i>	Low	Low	High
<i>Cranial capacity</i>	914 c.c.	1600 c.c.	1660 c.c. <sub>3</sub>

<i>Forehead</i>	Narrow and receding	Receding	Vertical
<i>Supra orbital ridges</i>	Continuous	Immense and continuous	Low and wide
<i>Orbits</i>		Large and widely separated	Wide and rectangular
<i>Occipital region</i>	Presence of occipital protuberance. The nuchal plane is less inclined than in man.	The whole surface is rough which indicate strong muscular impression.	It bulges behind and forms a marked flattening in the lambdoid region.
<i>Lower jaw</i>		Large and massive	Strong but not massive.
<i>Chin</i>		Absent	Fairly present.
<i>Teeth</i>	Enormous size with many simian features	Strong but not enormous ; mostly human in arrangement.	These are human in size and arrangement.

1. The Neanderthal man was first known, in the year 1856, from a cave of the Neanderthal, valley of a small stream near Dusseldorf, Germany.

2. Measured by Keith.

3. This figure is according to Keith ; Boule has estimated it at 1590 c.c.

*PLEASE NOTE :* Read NEANDERTHAL, in place of SINANTHROPUS in the 2nd line.  
Read 'roof' in place of 'root' in the 14th line.

much lower, the cheek bones are less prominent and the lower jaw is orthognathus, while the latter exhibit a very marked alveolar prognathism, the nose is much prominent. The Chancelade man can not be regarded as the ancestor of the modern Eskimos. Hooton also has come to the conclusion from various studies that the Chancelade origin of the Eskimos can not be accepted.

### The Cro-Magnon and the Chancelade.

The Cro-Magnon and the Chancelade men do not differ much in physical features and, therefore, some are of opinion as to group these two fossil types in a single head. But it has been seen that in certain features these two types differ from each other which may be summarised below.

<i>Characters.</i>	<i>Cro-Magnon.</i>	<i>Chancelade.</i>
1. Stature	Gigantic height	Small stature
2. Face	Disharmonic	Harmonic
3. Orbit	Rectangular	Quadrilateral

## MEN OF THE MESOLITHIC PERIOD

*During Mesolithic times the prehistoric men had to face a new environment, conditioned partly by the rising sea-level and partly by the change of climate. This period is marked by the withdrawal of the ice and the first appearance of agricultural and stock-raising communities. What were those people who brought a revolutionary change, first of all, in the way of life?*

In between the Palaeolithic and Neolithic cultural phases there is a series of cultures which bridges the gap between the Palaeolithic food gathering and Neolithic food producing stages. This transitional stage is known as the Mesolithic period. The Mesolithic period is characterised by the use of pigmy stone tools technically known as the *microliths*. Just after this stage the climate of Europe changed completely due to the retreat of the great glaciation, i.e., Wurm. Remarkable changes also took place in the population pattern and cultural activities which developed in such a rapid speed that the human life experienced a thorough change. In this transitional period a new group of *Homo sapiens* emerged whose physical features and cultural activities are most important in various aspects. They mark the emergence of the first brachycephals in the soil of Europe. Three important series of fossil men of this period have been discussed below for general introduction.



### The Mugem Man

A large number of skeletal remains have been discovered in a late Mesolithic layer near Muge in Portugal. The layer concerned has presented many artifacts which resemble those of the Tardenoisian Industry. Paulae Oliveria, first of all, seriously studied the characteristic features of the said bone remains. Then the other scientists also took up the work of investigation and published their views in so many journals. All of them agree in the point that these skeletal fragments belong to two separate groups of individuals.

The first type exhibits the following characteristics :—The stature is small (about 5 ft. 8 inches) ; the head is dolichocephalic and hypsistenocephalic. The face is long and it is harmonious in proportion. A slight alveolar prognathism is noticed. The nose is medium and the eye brow ridges are projected.

Quatrefages calls this type as 'Mugem Race'. Mendes correa has found archaic characters in this type and described it as very ancient representatives of *Homo mediterraneus*.

The second type is represented by a smaller number of skulls which show brachycephalic features. Somebody are of opinion that these belong to *Homo alpinus*. One skull of this group shows Mongolian characteristics. Regarding this type of brachycephalic skulls Boule opines that these are, in reality, mesocephalic. It is not wise to place these in a separate group. According to him, these are nothing but a variant of the true dolichocephalics.

### The Teviec Man

The skeletal remains of a group of individuals belonging to the Mesolithic age have been unearthed from Teviec in Brittany, France. The associated finds reveal that these people were coast dwellers who used to live mainly on sea-shells and fishes. The artifacts found with the bone remains are of Azilo-Tardenoisian type. The human skeletons from Teviec consist of 15 adults (7 males and 8 females), a girl between

14 and 16 years and 7 children upto 5 years of age. All these skeletal remains have been unearthed in a good state of preservation and that is why the Teviec discovery is regarded as most important.

The statures of the Teviec skeletons are short—5 ft 2 inches for males and 4 ft 11 inches for females. The skulls are somewhat larger than those of the Mugem men. The crania are thick. The cranial index ranges between 72 and 77. In form, therefore, they are dolicho-mesocephalic. The vault is high with an almost oval contour. The supra-orbital ridges are wide. The face is broad and low. The orbits are rectangular. The nose is mesorrhine, and the palate is wide. The lower jaw is massive and it possesses a projecting chin. The teeth are large and some of them show primitive features. In fine, the Teviec man falls in the intermediate place between the Aurignacian-Magdalenian type and the Mediterranean type represented by the people of Muge.

### The Ofnet Man

In 1907 and 1908 R. Schmidt excavated the Ofnet cave near Nordlingen, in Bavaria. Two shallow pits in this cave presented a number of human skulls painted with red ochre. The layer in which these skulls were found also presented many artifacts belonging to Azilian cultural phase. The total number of skulls excavated here is 33 of which 19 are of children, 10 of women and 4 of adult men. Reconstruction of only 20 skulls have so far been made and studied in detail. These skulls exhibit an extraordinary mixture of types. In forms some of the skulls are dolichocephalic, some are brachycephalic and others are mesocephalic. The cranial index ranges from 70 to 87. The first group of five skulls have long faces and in this character they differ from the dolichocephalics of the upper palaeolithic time. According to Schilz they belong to the group of *Homo mediterraneus*. The second group of eight skulls represent the ancient brachycephalics. The

other skulls which are mesocephalic in forms have originated from crossing according to a noted German scientist.

The bone materials of Ofnet have been studied by various scientists at different times. All of them have distinguished the three groups mentioned above. The dolichcephalics have been compared with a few individuals belonging to the upper Palaeolithic period. The mesocephals resemble the Tevies man to some extent. The brachycephals are sometimes regarded as the forerunners of the Alpine race.

A cave of the Hohlenstein in the Swabian Jura presents three skulls belonging to Azilian stage which resemble the most of the skulls found at Ofnet.

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## THE PILTDOWN HOAX

Mr. Charles Dawson, a lawyer of England, discovered in the year 1908, the most controversial fossil remains at Piltdown, in Sussex, England. One day while walking along a farm road in Fletching district, Mr. Dawson found several peculiar brown flints which were very unusual in the said area. On enquiry he came to know that they were unearthed from the gravel bed of the farm. He then paid a visit to the exact site and wanted to know from the labourers whether they had discovered any bone remains. One of the labourers presented him a small portion of unusually thick human parietal bone. Mr. Dawson began to search continuously since then and, in the year 1911, he found a part of frontal bone of the skull including the outer upper corner of eye socket. Mr. Dawson sent those materials to Sir Arthur Smith Woodward, the palaeontologist of the British Museum. They employed their own men to carry on the excavation work and as a result of which several fragments, such as, a part of upper portion of the skull and the ear region, a portion of occiput, half of the lower jaw bone were unearthed. Then in 1913, two nasal bones, a canine tooth were found and finally, in the year 1915, were discovered a fragment of frontal bone, a fragment of the occiput, and another molar.

The Piltdown gravels yielded a number of flints and one well-preserved Palaeolithic worked flint, most probably of the Mousterian age. Also a large bone implement was found. The fauna includes the remains of both Pleistocene and Pliocene animals. Fragments of the teeth of a mastodon, of stegodon, and of a rhinoceros were found there. The remains of hippopotamus, beaver, etc. were also discovered.

Prof. Woodward had attempted to reconstruct the fragmentary bones of the Piltdown gravel and believed that the possessor of those bones was a very primitive form of man

that represented the dawn of humanity. He called it as the *Eoanthropus dawsoni* or the Dawn man. The specific name of the Piltdown man was given in honour of Mr. Dawson.

The Piltdown man caused a great disturbance in the scientific world regarding its geological age, physical features and everything. It had been discussed by different authorities in different scientific journals but the problem was not solved.

Some scientists said that the skull and the mandible belonged to the same individual, whereas others opposed the view. Arthur Smith Woodward was a supporter of the former view. Weinert, a German anatomist, examined the fragments of Piltdown skull and jaw and came to the conclusion that those were in possession of the same individual. Those who had advocated the jaw and the skull belonging to same individual said that the jaw was discovered just at the spot where the occiput of the skull was lying undisturbed. They also remarked that the mandible did not belong to the ape as no trace of fossil ape had ever been recognised from the soil of Europe.

But from the very beginning Prof. Waterston expressed his view that the skull and the mandible did not belong to the same individual. Miller, a famous American mammalogist, declared, after careful examination, that the jaw belonged to the Pleistocene species of chimpanzee. Frassetto, an Italian scientist, expressed his view that the said jaw was definitely simian in character but that belonged to the orang and not to the chimpanzee. H. F. Friederichs studied the Piltdown remains and came to the conclusion that the cranium belonged to an individual of *Homo sapiens*, and the jaw and teeth did never belong to the same individual but to an unknown ape of Tertiary age to which he gave the name *Boreopithecus*. On the whole, the Piltdown man had been creating a mysterious atmosphere regarding himself since the day of his discovery.

The riddle of the Piltdown man has now been solved by Messrs Weiner, Le Gros Clark and Oakley who, by applying

their new method of dating have declared that the Piltdown material is, out and out, a hoax. They have applied a method—the 'flourine test'—by which the true age of a fossil find can be correctly established. In the ground-water there is always a small quantity of flourine and this reacts with the hyapatite in the bones and form fluorapatite which is an extremely soluble mineral. It is most resistant to withering or other alterations and, in course of time, the fluorapatite undergoes gradual and progressive increase. The structure of this is dependent on time only. From the flourine content of the bone the relative age can be determined more correctly than any other experiment.

When the Piltdown remains were examined by the new method, it was seen that the flourine content of the bone was so small that they could not be so ancient as had been assumed. At the end of the year 1953, and later in the middle of 1954, a new light was thrown by Dr. Oakley and others regarding the fate of Piltdown remains. They declared firmly that the Piltdown skull, which was supposed to be the skull of a missing link, was a fraud. The cranium was undoubtedly of a man, whereas the jaw belonged to an ape, who died approximately at the age of ten.

The Piltdown man did not find any correct position in the evolutionary tree of man. Being struck by the unnatural condition of the Piltdown remains, Weiner started a scientific investigation on these. The nitrogen content of the bones of the Piltdown man was examined. In modern bones the nitrogen content is very high, while in the fossils it is too low. The modern bones exhibit 4.1 per cent nitrogen. The nitrogen content of the Piltdown jaw was 3.9 per cent, while bones of the skull exhibited 1.4-0.6 per cent. This examination proved that the mandible was far modern and it did not belong to the skull. The lower jaw belonged to a modern ape. The canines had carefully been removed and the molars had been filed down in order to produce a chewing surface like that of a modern

man. The colourisation of the fragments was also artificial. In order to keep a symmetry with the ferruginous nature of the deposit the Piltdown remains were painted with reddish brown colour. The chemical analysis detected that the colourisation was restricted to the surface of the bones only. The associated bones of the animals and the stone implements were also artificially coloured.

Now the riddle has been solved. The Piltdown fragments and other associated materials are false in every respect. It is a case of scientific forgery. The palaeontologists will ever remain grateful to those scientists who, after painstaking researches, have made it possible to solve the problem of Piltdown man.

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PART FOUR

**ETHNOLOGICAL STUDIES**





## HEREDITY AND GENETICS

*It has been found that there is a biological basis on physical feature which, in turn, is dependent on hereditary mechanisms. One should be well-acquainted with the underlying significance of these factors before one starts for taking up the problem regarding the origin and spread of the different varieties of mankind. What light do they throw on the solution of the problem ?*

A genetic relation exists between the parents and the offsprings. In general, offsprings tend to resemble their parents ; tigers produce tigers, elephants give birth to elephants, and human beings bring forth human beings. This similarity, though not exact, is due to their having inherited the characteristic features of the parents. The tendency of inheritance of paternal characters is known as *heredity*. The heredity and its mechanisms should be well understood in order to get a proper idea regarding the origin of man and the significance of his different races. The science of genetics is an important discipline which deals with the various laws of inheritance ; and naturally it helps us in understanding the internal features of human evolution. The genetics of today began to develop mainly as back as 1910 by the active interest of T. H. Morgan. The chromosome theory of heredity of that time has been accepted today by the Geneticists of all the corners of the earth. It advocates that chromosomes play the role in transmitting the hereditary traits ; each chromosome is

composed of certain units known as genes, each of which is responsible for one or more hereditary qualities.

Though it has been said that like animals produce like animals, yet no two animals are exactly alike so far as their physical features are concerned. The two brothers (except some identical twins) may be superficially alike but in certain minor details they tend to go further from each other. This difference is known as *variation*. The variations are commonly found, in greater or lesser degrees, in the living organisms and the significance of this should be understood as it plays a great role in the evolution of new forms. Variation may be described as a fundamental change in the internal organisations of the individual mostly due to the influence of certain physical and chemical forces which change the chemistry of the genes. Sometimes the genetic and environmental influences jointly cause variation in the animals or plants. Most of the time variation proves useful as it gives the possessors an advantage over others. For example, sheep which have developed thick coat of wool will naturally get much protection from the severe cold than the others whose wools are scanty. Variations may be of two types—small and large. Small variations occur in every individual and due to this fact no two persons look exactly alike. But sometimes marked changes take place between parent and offspring. This is known as *mutation*. The importance of mutation had been, first of all, pointed out by De Vries of Holland. After repeated experiments with *Oenothera lamarckiana*, he formulated the theory that new species suddenly appear without intermediate steps; and this newly developed species are able to transmit all their characteristic features to their offsprings by inheritance. Sometimes it is said that mutation has played an important role in the origin of various races of mankind.

### THE EXPERIMENT OF MENDEL

Various characteristics in living organisms are inherited by regular laws through a particular mechanism. This is

known as hereditary mechanism. Formerly, it was believed that blood took the main part in transmitting the characteristics of the parents to the offsprings. Therefore, the ideas like 'related by blood', 'blood-kin' etc. developed in most of the human societies. This type of idea came into the mind of man due to the improper knowledge in the subject of heredity. Blood was regarded, at that time, to be the carrier of bravery, wisdom, fertility and other important features. That was why some persons vehemently objected the use of blood plasma of the Negroes in saving the lives of the wounded white soldiers during the World War II. But in course of time the scientists understand that it is not the blood but certain unit characters present in each and every individual are responsible for inheritance of various characteristics from the parents to the offsprings. These unit characters are the *genes*.

An Austrian Monk, *Gregor Johan Mendel* (1822-1884) deserves all the credit for discovering the exact nature and modes of inheritance in the organism. The discovery, which took place not inside a Research laboratory but in a monastery garden, brought a revolutionary change in the line of thinking relating to heredity.

Mendel carried on original experiments with the different kinds of plants, especially garden peas, within the jurisdiction of his monastery garden. He also did some works on the bees but unfortunately the result had been lost. Mendel worked on the garden peas from 1857 to 1865 and studied carefully all the genetical features through several generations. He then sent his result of experiment to his former teacher, Karl Nageli, for discussion. But unfortunately his teacher could not find time to look into Mendel's work as the former was very busy, at that time, with his great pressure of work. In 1866 Mendel's works were published in the '*Transaction of the Natural History Society*' of Brunn. The circulation of that particular journal was very limited and, therefore, the report of Mendel's painstaking works hardly reached the learned societies

of the various parts of the world. However, Mendel's valuable works remained uncared for several years due to the fact that proper evaluation of the works could not have been possible by the people of that period. At that time the knowledge regarding the cell structures, behaviour, chromosomes, genes and other factors on which heredity depends was very limited.

In 1884, death snatched away Mendel from this earth. Sixteen years after the death of Mendel three scientists of different nationalities independently made the discovery similar to that of Mendel. Those scientists, whose conclusions supported Mendel in all respects, were De Vries of Holland, Von Tschermak of Austria and Correns of Germany.

In order to solve the riddle of heredity Mendel hybridized certain varieties of garden peas and kept a careful record of all the characters transmitted in various generations. He chose the garden peas for his experiment due to some special advantages. This particular plant is a normal self-fertilized before the flowers open and, therefore, in it there is no chance of accidental outcrossing by the insects and other agencies. Also this plant gave Mendel an opportunity to study long process of crossing and noting the exact percentage and characters of the descendants and of the parents in a comparatively shorter time.

Mendel's method of study is very simple and it can be repeated by any careful person who is able to observe the results of controlled matings in plant and animal species. It is better to discuss the difference between normal self-fertilization and artificial hybridization before the detailed study of Mendel is taken into consideration. Self fertilization takes place when the two *gametes* unite to form a *zygote* which develops into a seed and ultimately into a plant, are derived from the pollen and ovule of the same flower. Peas, with which Mendel experimented, do not present natural hybrids. In order to cross artificially the normal self-fertilized flowers, the stamens should be cut down carefully before the pollens attain

maturity. Then, by transferring pollen grains from the flower of another plant of the same kind to this depollanised flower the artificial crossing can be effected.

According to Mendel, when parents who differ from each other with respect to any character are crossed, the hybrid progeny in the first generation will not be the intermediate between the two with respect to the character in question, but their characters will apparently be like one of the parents. Therefore, it is seen that of the two different sets of characters of the parents one remains suppressed within the offsprings while the other comes to light. Mendel calls the character that remains apparent in the hybrid progeny as *dominant*, and the latent character as *recessive*. When such hybrid offsprings are crossed with each other the result will be very interesting. In this generation, the mixed progeny thus produced will be 25% like the dominant grandparent, 25% resemble the recessive grandparent, and the rest 50% will look like the hybrid parents themselves.

Mendel started his experiment by breeding tall and dwarf varieties of pea plants. He discovered that when the tall varieties of pea plants were artificially crossed with the dwarf varieties, all of the offsprings, thus produced, became tall like one of the parents. First of all, Mendel collected pure-bred of tall plant by the process of breeding between the tall plants for several generations. Pure-bred of dwarf plants were also collected by him by the same process. Then he crossed artificially the pure-bred tall with the pure-bred dwarf plants. The hybrid offsprings, in this generation, were all exclusively tall and there were no trace of intermediate forms showing a blending of two characters. This generation is known as *First filial generation* or  $F_1$ . When the hybrid offsprings of  $F_1$  generation were, in turn, crossed with each other, the nature of their offsprings became different. It led to the production of a mixed generation of tall and dwarf varieties in the ratio of 3:1. In this *Second filial generation* three-fourths of the plants

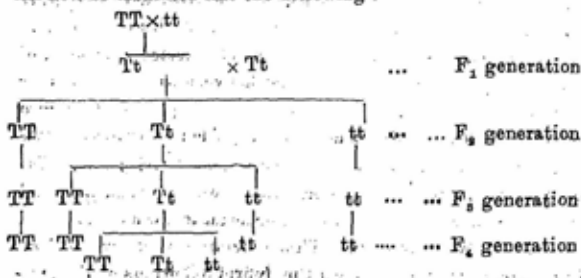
were tall like the hybrid parents and one-fourth dwarf resembled their grandparents. The dwarf plants, thus produced, were subjected to further breeding and it was seen that they always gave rise to the dwarf offsprings, while the tall ones turned out to be genotypically of two kinds. One-thirds of them proved to be as pure tall like their pure tall grandparent, whereas two-thirds as hybrid tall resembling their parents. It is interesting to note that these hybrids, when interbred, will again give rise to tall and dwarf varieties of plants in the ratio of 3:1.

If we denote a pure tall plant as T, and a pure dwarf variety as t, Mendelian crosses may simply be expressed as follows :—

Tall (TT)  $\times$  Dwarf (tt) = Tall (Tt).

Tallness is always dominant over dwarfness. In (Tt), dwarfness is present but latent. Such a pair of characters are known as *allelomorphs* or *alleles*. When the alleles are alike, such as (TT) or (tt), these will be termed as *homozygotes*. But when they are composed of two unlike members, as (Tt), they should be called as *heterozygotes* or *hybrids*.

Mendel's crossing experiments with tall and dwarf plants can now be tabulated like the following :—



Symbolical representation of monohybrid crossings.

Mendel carried out his epoch-making experiment with the garden peas by not limiting his observation in one set of character, but so many characters of the plants were taken into

consideration by him which may be noted as (1) Form of the seeds,—round or wrinkled, (2) colour of the cotyledons—yellow or green (3) colour of the seed coat—white or gray, (4) form of the ripe pod—inflated or constricted, (5) colour of the unripe pods—green or yellow, (6) position of the flowers—axial or terminal, (7) length of the stem—tall or dwarf.

After his successful experiment with one set of character, viz. tall-dwarf, Mendel tried to conduct the experiment of two-character crossing. He crossed a variety of tall and round seeded plant with a dwarf and wrinkled seeded plant. After mating pure-bred varieties of both types of plants he started his breeding experiment. In the  $F_1$  generation he found that all the plants were tall with round seeds. The plants produced in the  $F_1$  generation were then allowed to self-pollinate and the offspring resulted due to that union (in the  $F_2$  generation) showed the segregation of all the characters and they gave rise to four different types of seeds. The second filial generation produced nine-sixteenths tall and round, three-sixteenths tall and wrinkled, three-sixteenths dwarf and round, and one-sixteenth dwarf and wrinkled. The approximate ratio is 9:3:3:1. This type of crossing with two sets of character is known as *dihybrid crossing*. In the above experiment it is seen that tallness is dominant over dwarfness and roundness of the seed is dominant over wrinkledness.

Correns has observed another mode of inheritance in the case of four-o'clock plants (*Mirabilis jalapa*) which is very interesting in this regard. White and red flowering varieties of four-o'clock plants have been crossed by him and the various characteristic features have carefully been noted. First of all, pure strains of white four-o'clocks are secured by breeding the white flowers for several generations. The pure bred red varieties are also found by the same process. This generation is called as the parental generation. When the pure bred red and white flowers are crossed with each other, the resulting plants produce flowers whose colours will not be red or white but pink. Therefore, it is noted that in the first filial genera-



tion, the hybrids do not resemble any of the parents so far as the colour of the flowers are concerned. When the hybrid offsprings of  $F_1$  generation are crossed against each other, they produce three varieties of offsprings viz. red-flowered, pink-flowered and white-flowered. Thus, it is seen that some of the flowers of  $F_2$  generation resemble one of the parents, some look like the other parent and some show the colour similar to that of  $F_1$  generation. The ratio of the red, pink and white flowering varieties of plants, produced in the  $F_2$  generation, is 1 : 2 : 1, which fundamentally support the familiar phenotypic ratio of 3:1 or three coloured to one white. The white flowers of the  $F_2$  generation when crossed against each other, they give rise to only white flowering varieties of plants. Similarly, the red flowers produce their same kind when they are inbred. On the other hand, the pink flowers, when crossed amongst themselves, produce red, pink and white flowering varieties of plants in the ratio of 1:2:1.

Similar hereditary behaviours are also met with when black and white varieties of Andalusian fowls are crossed. If the white fowls are crossed amongst themselves, they do not produce any kind of offsprings but white. Similarly black varieties also give birth to black offsprings when inbred. When such white and black fowls are crossed with each other, the colour of all the offsprings, in the  $F_1$  generation, will be blue unlike both of the parents. The hybrid offsprings are then allowed to inbred and, in the  $F_2$  generation, it is found that 25% of the offspring are pure white, 50% are blue, and 25% are pure black. Thus the ratio is 1:2:1. Then the different offsprings of  $F_2$  generation are allowed to inbred and the result is carefully noted. White fowls produce white offsprings, black ones give birth to black ones, and the blue varieties bring forth to white, blue and black fowls in the ratio of 1:2:1.

From the above experiments, we get apparently two types of ratios 3:1 for the garden peas and 1: 2: 1 for the four-o'clocks and the Andalusians. But, in reality, they do not differ fundamentally. The only difference in four-o'clocks and Andalusians

is that each phenotype indicates a distinct genotype, while in the case of garden peas this rule does not hold good. The offsprings produced in the  $F_2$  generation cannot be distinguished by their phenotype in the case of the peas. For example, all the tall plants in the  $F_2$  generation are phenotypically identical, but genotypically they are of two types—some are pure tall and others are hybrid tall.

### The Laws of Mendel

Mendel carried out his breeding experiments for a long time with the garden peas and observed the inheritance pattern from various angles. He, then, summarised his observations into the following principles known as the laws of Mendel.

#### (1) *The law of Segregation*

The hereditary characteristics pass from the parents to the offsprings through the gametes which form the connecting links between successive generations. The various characters in the zygotes in  $F_1$  generation do not completely mix, but they are segregated into the various sex cells of the hybrid, and in the offsprings of the hybrids a particular character of their parents will reappear which has passed undisturbed through the hybrid. In the above experiment it has been seen that when the hybrid pea plants of  $F_1$  generation, all tall phenotypically, are allowed to cross they produce both tall and dwarf varieties in the ratio of 3:1. However, it is seen that the dwarfness has been out of sight for sometime and, in the  $F_2$  generation, it appears again. These dwarf plants when inbred produce only dwarf varieties. Therefore, it is clear that though the dwarfness has been suppressed in the  $F_1$  generation by the tallness, yet its character remains unchanged.

#### (2) *The law of Independent Assortment—*

The principle that involves in the dihybrid and polyhybrid crossings is known as the law of independent assortment. The different pairs of characteristic features that come together in the  $F_1$  generation during a dihybrid or polyhybrid crossing

separate out in the  $F_2$  and other succeeding generations. Each pair of characters inherit independently of the other.

(3) *The law of unit character*

This law advocates that each factor in the gametes behaves as an independent unit character which inherit independently of other factors.

(4) *The law of Dominance*

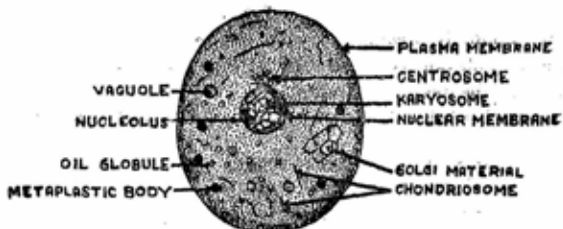
According to this law, when the individuals with two contrasted characteristics, such as tallness and dwarfness, are crossed, one of the characters predominates the other in the offsprings. Thus the hybrid plants exhibit one of the pairs of contrasted characters.

## THE CELL—ITS STRUCTURE AND DIVISIONS

The body of each living organism is composed of cells which are very minute in size and too complex in structure. The form of the cells varies in different parts of the body. Since the cells are the structural and functional parts of the body, their modes of behaviour should be well understood in order to have a correct idea regarding heredity. During Mendel's time, though the cell was discovered yet various mechanisms of the different finer parts of the cell were not known. The chromosomes, the genes—which are regarded as the players of most important roles in inheritance—were unknown to the workers. Still Mendel showed considerable credit in his experiments with the garden peas. The development of the science of genetics started greatly as back as 1910 under the direct leadership of T. H. Morgan. Since then various new facts are being unfolded by the different geneticists which have given birth to the complicated nature of modern genetics. But here we shall restrict our study of genetics to those parts which are useful in getting an idea about the fundamentals of man's inheritance.

Now let us discuss the structure of the cells—the component units of the body. The cell is composed of *protoplasm* with a *nucleus*. The protoplasm is a jelly-like fluid and is made up

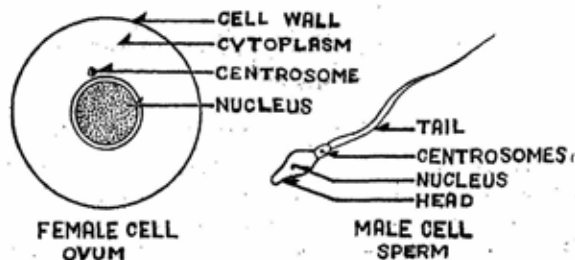
of various chemical substances. It has been called as the 'physical basis of life.' In each and every living organism it serves as the basis. It has also been termed as 'the vehicle of vital activity'. The superficial protoplasm has been specialised to form the *cell membrane* which forms the outer boundary of the cell. It controls the entrance and exit of various chemical substances. The protoplasm of the cell outside the nucleus is called as *cytoplasm*. In the cytoplasm various living and non-living bodies are found. Of the living elements the *central body*, *mitochondria*, *golgi elements* and *plastids* are important.



The Structure of an animal cell.

The *nucleus* is the highly specialised and essential part of the protoplasm and it controls the metabolic activities of the cell. The shape of the nucleus is generally spherical and it is surrounded by a membrane known as the *nuclear membrane*. A jelly like substance which fills up the nuclear cavity is called as the *nucleoplasm*. A network of delicate threads, the *nuclear reticulum*, lies in the nuclear cavity which is composed of a stainable substance—the *Karyotin*. Within the nucleoplasm are found one or more (generally two) small spherical bodies known as *nucleoli*. The nucleus is regarded as the 'dynamic centre of life' as it spreads a direct influence on the various activities of the cell. It is the nucleus of the cell which plays the great role in transmitting the hereditary characters from the parents to the offspring.

The patterns of cell division are of utmost importance in understanding hereditary features. In man, the cells can be divided into two main types—the somatic or body cells and the germ or reproductive cells. The former ones help in construction and maintenance of various bodily structures, whereas the latter are useful in reproducing new species. It is the germ cell which establish continuity from species to species in each successive generations. The somatic cells perish with the death of the individual but the germ cells are potentially immortal. The germ cells can again be sub-divided into—sperm cells (male), ova or egg cells (female), and zygotes, which are formed by the union of a male and a female sex cell. Similarly, according to the nature and functions, the somatic cells can also be sub-divided into nerve cells, muscles cells and the like. The human ovum or egg cell is spherical in shape and it is hardly visible to the naked eye. It has been



Diagrammatic representation of Ovum and Sperm.

(After Beals and Hoijer)

said that twenty million human eggs will weigh about one ounce. The sperm or male sex cell is about eighty five thousand times smaller in size than that of an egg. Its shape is thread-like inflated at one end to form a head. The nucleus is situated at the head; the thread-like portion is used as a tail for producing movement.

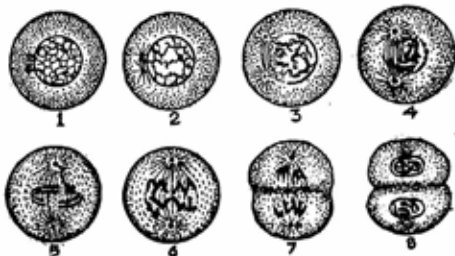
From the above description it is seen that male and female

sex cells differ greatly in size, appearance and structure. But male and female sex cells contribute equally to the hereditary qualities of the offspring. How the two different varieties of cells convey the same hereditary traits? After various examinations the scientists have been able to solve the problem. There must be some similar parts in the male and the female sex cells where lies the machinery of inheritance. These similar parts are nothing but the nuclei of both the cells or more particularly the chromosomes present in the nuclei. The chromosomes are then regarded as the essential agencies in the transmission of hereditary traits. Chromosomes have taken their names due to the fact that they readily absorb dyes and stand out in very strong colour when cells are stained. They are visible under the microscope when the cells become ready to divide. Each chromosome is made up of units called *genes* which are arranged in a linear series and, as have been said earlier, they transmit the characteristics from parents to offsprings. The number of chromosomes in the cell of a particular species of an animal remains constant. This number ranges from 2 to 200 and more. Thus, in toad the number of chromosomes is 8, in dog 22, and in man, it is 48. They also differ in size and form in the different species of animals. Any difference in the chromosome constitution of a species of animal is resulted in the change of the nature of the animal concerned. The chromosomes, therefore, called as the 'physical basis of heredity'.

A new life starts when a sperm fertilizes an ovum. Fertilization means the fusion of the nucleus of the sperm with that of the ovum. The new cell, thus produced, by the union of the sperm and the ovum, is known as the *zygote* which begins to divide into two, four, eight, and finally billions of cells which build up the body of the individual concerned. From the beginning some of these cells are set apart to form the germ cells, while the others go to form the various bodily organs and, therefore, known as somatic cells.

The process of cell-division is not a simple one but it is

accompanied by complicated changes in the substances of the nucleus. At the preparatory stage to cell-division the nucleus becomes larger. The central body lead the division of the cell. It divides into two and each of them is then surrounded by a halo of radiating fibres called *astral rays*. After this, they move towards the two poles of the nucleus. At this time the nuclear reticulum separates into a definite



Different stages of Mitosis

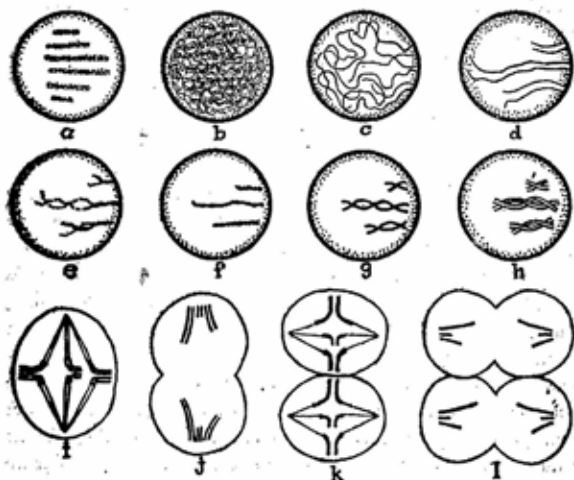
number of slender, thread-like bodies—the *chromosomes*, which gradually become straight and thick, and lie more or less parallel. Then through a complex process, each chromosome divides lengthwise and give rise to two daughter chromosomes each of which is known as *chromatids*. In the meantime, the nuclear membrane disappears and the chromoses lie on the nuclear sap. Then certain fibres appear there, which are developed partly from the reticula and partly from the cytoplasm, and extend between the two rayed central bodies or asters. It assume the form of a spindle. The chromosomes remain attached to the fibres of this spindle, at the equatorial plane of the cell, by the definite points known as the *centromeres*. Then the daughter chromosomes are repelled from each other and they separate. The spindle elongates and the daughter chromosomes go to the opposite poles. After this separation the chromatids at each pole unite and gradually coil up and ultimately form the nuclear reticulum. The

spindle disappears and a groove appears in the cytoplasm which deepens until it divides into two halves. Thus, from a single cell two daughter cells develop, through a complicated process, each of which is identical in every respects with the parent cell. The process of cell-division just described is known as *mitosis*, the significance of which is that the number of chromosomes remain unaltered in all of the daughter cells.

But when a sexually mature individual produce sperms or eggs the cell-division pattern differs totally from that of the former. At this period the germ cells within the body of the individual undergo a peculiar division in which the diploid number of the chromosomes become reduced to haploid (half) number. Therefore, this is known as the reduction division or *meiosis*. The meiosis at the time of maturation of the male gametes is known as *spermatogenesis*, and in the case of the female gametes it is known as *oogenesis*. The significance of meiosis lies in the fact that the number of chromosomes in a species remains constant. We have already seen that new life occurs due to the fusion of male and female gametes. In the zygote the number of chromosomes becomes double that of the gamete as it receives half the number of chromosomes from the spermatozoon and half the number from the ovum. Thus, if the reduction in the number of chromosomes does not occur in the male and female gametes, the number of chromosomes in an individual will be increased to double the number; and this doubling will continue in each generation. For example, an organism has 14 chromosomes in its cells. If no reduction in the number of chromosomes takes place during the formation of the gametes, the zygote formed by the union of male and female gametes of the said organism will contain 28 chromosomes. This 28 will be 56 in the next generation, and in this way the number will continue to increase. Therefore, the only solution of this problem is meiotic division which takes place in a very complicated and at the same time in a very interesting way. At the first stage of meiotic division the chromosomes appear in diploid number as slender



thread-like bodies. Next the identical chromosomes unite in pairs. This type of pairing is technically known as *synapsis*. Due to this phenomenon the number of chromosome in a particular cell reduced to half. The paired chromosomes are called by the term *bivalent* which gradually coiled around and become thicker and shorter. Then longitudinal splitting of the chromosomes takes place and as a result each of the two members of synapsed pair becomes double, each of which is composed of two chromatids. Chromosomes are now begin to separate. But complete separation does not occur as they



Diagrammatic representation of the different stages of meiosis  
(Adapted from Marisland)

remain attached to several points. Some parts are, naturally, interchanged between the homologous pairs of chromosomes during this separation, and the phenomenon is known as *crossing over*. The chromosomes then further shorten. Next, the nuclear membrane disappears and the homologous

chromosomes lie in the equatorial plane of the cell. The spindle develops from the karyolymph and on the fibres of which each pair of chromosomes remains attached by centromere. In the next stage the homologous chromosomes separate and form two groups, each of them travel to the polar region of the cell. The daughter nuclei, thus formed, contain haploid number of chromosomes. Each of those nuclei takes rest for sometime and undergoes another division which is mitotic in nature. Therefore, ultimately there are four daughter nuclei with haploid number of chromosomes. This is, in short, the process of reduction division of cells. But the process itself is more complicated than is put in the above lines.

#### Maturation of the gamets : Gametogenesis

The germ cells divides mitotically in repeated successions and develop into spermatogonia and oogonia which ultimately bring forth to spermatozoa and ova respectively. When a spermatogonia stop multiplying by mitosis, it indicates the beginning of the meiotic division. Each germ cell is now called as a primary spermatocyte. At this stage the pairs of chromosomes engage themselves in synapsis. The *primary spermatocyte*, by meiotic division, gives rise to two secondary spermatocyte with haploid number of chromosomes. These divide again mitotically and give rise to four *spermatids* which ultimately grow into *spermatozoa*. The whole process is known as the *spermatogenesis*. *Oogenesis*, or the formation of eggs, also takes place in the similar way as is found in the *spermatogenesis*. The primordial germ cell, by mitotic division, gives rise to *primary oocyte* which, in turn, divides meiotically and produces *secondary oocyte* and first polar body with haploid number of chromosomes. Then the secondary oocyte undergoes an unequal division forming an ovum and a secondary polar body. Oogenesis differs from spermatogenesis in a certain cases. During the growth period the primary oocyte becomes very much larger than the primary spermatocyte due to an accumulation of yolk. The two divisions in the

case of the oogenesis are highly unequal. The ovum receives most of the portion of yolk and cytoplasm, whereas the polar bodies receive only an insignificant portion. The egg, when fertilized, develops into an embryo, but the polar bodies do not take part in it and ultimately they are lost.

The above discussion is an attempt to give a fundamental idea on the basic principle of heredity. It has already been cleared that blood does not play any role in the hereditary mechanism, but it is the gene which is responsible for this. These are received by individual from the parents and the latter, in turn, passed them on to his children according to the laws of Mendel. The people differ amongst each other due to the difference in gene. Some genes carry most useful characteristics like good health, high intellect, sharp memory etc. whereas there are others which transmit evil features and various diseases. However, it has been taken for granted that the distinctive individuality of a person depends not only on parental heritage, but also on environmental conditions. In the following lines a short discussion regarding heredity and environment will be made for understanding the importance of environmental conditions in shaping the form and function of each individual.

### Heredity and Environment

People differ from one another due to two basic reasons—heredity and environment. There is much controversy on the point whether heredity is more important than environment or vice versa. Now this should be discussed scientifically in order to get a clear understanding regarding the facts. The relation of life and environment is intimate. Each organism may be regarded as the product of past life and present environment. The experimental biologists have shown that when the dandelion plants, after dividing into two halves, transplanted in two separate environmental conditions, they have developed two different sets of features though each half possesses similar hereditary characteristics. This fact can also be illustrated by citing

examples from the human social groups. Our common knowledge tells us that the people in a hilly region differ from the people who inhabit in the plain part of the country. People undergo a process of change as their environment changes. This is why we see that people change from country to city, from mountain to plain, from agricultural to industrial life and from hot to cold climate. Scientific investigations regarding the influence of environment on human life have shown that the population of the same descent change with the change of the environment. From an experiment, Otto Klineberg has found that the Negro children who have come from rural to urban areas show more intelligence than the children who still live in the rural districts or have recently come to the city.

It is true that heredity of a person cannot be changed ; but if he is placed in a favourable environment, his heredity may respond favourably. Formerly heredity was regarded as the destiny and throughout the life it would remain unaffected by any external force. But the present knowledge have given us the idea that distinctive individuality of a person depends on the environmental conditions besides the hereditary mechanism. Diabetes is, to some extent, a genetic disorder and this can be checked, more or less, by using insulin. It is true that insulin does not change the hereditary feature of the patient suffering from diabetes but he will get some relief from the disease due to the changed environment within the body caused by the application of insulin. Environment, thus, may be called as the conditioning factor of life. It is as important as heredity in the shaping of form and function of an individual. The particular kind of character an individual develops is depend on the nature of environment in which he is being reared up.

Formerly it was believed that the human foetus within the womb of the mother was completely cut off from the outer world. But with the advancement of knowledge regarding embryological factor, it has been clear that the human embryo is affected by all sorts of influence of the outer world. The normal structure and function of the future child depend largely

on the external environmental conditions. It should be remembered that the genes which are the bearers of hereditary features do not work in a vacuum. The different activities of the hereditary features mainly depend upon environmental conditions which are of three types—(a) the intercellular environment, (b) the uterine environment, and (c) the extra-uterine environment.

On the whole, it is clear that there is no reason to think that heredity is stronger than environment or vice versa. Heredity and environment should not be approached in this way. Both these factors are equally important and none of these two can be isolated. Both spread influence on an individual and each influence is unique. An individual receives his hereditary features through genes which show their activities under the environmental conditions.

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## THE STUDY OF RACE

*From earlier times, people have been using the term race in a wrong way, and this misconception has been creating many acute problems in the socio-political life of the people of the world. Here an attempt has been made to look at the subject of race in a purely biological sense. Is there any scientific solution to the various problems of race that have been resulted from erroneous conception ?*

### WHAT IS RACE ?

The Race itself is a problem. From time immemorial, peoples of different countries have been using the term race in a wrong way. It has been used to denote a group of persons living in a country for several generations, such as the English race, the Chinese race etc. Sometimes a culturally homogeneous people has been called as race. In Germany, in the Nazi period, the nation was divided into two races—Aryan and Non-Aryan. The intention of that division was to fulfil some political purposes. Due to the bad connotations various problems regarding the term race have been resulted. Still today in most of the forms of applications for admission in schools and colleges, or for appointments in various organisations a column is found which reads as, 'to what race do you belong ?' This is certainly a misuse of the term race. But the anthropologists look at race in a purely biological sense. To them, a race is not a family, not a nation or not a group

with common interest. The race is a biological phenomenon in its essence and it must be defined in biological terms.

We have already seen that all modern men belong to one genus and species, *Homo sapiens*. It does not necessarily indicate that men living in various parts of the world are all alike in physical features. Within this great community of man there exist smaller groups, and between which there is little or no intermarriage. This type of isolation is associated with differences between the groups regarding the frequency in which certain biological characteristics develop in them. Thus, the different groups such as, the Negroes of Africa, the Mongoloid peoples of Asia, the Europeans differ from each other in certain traits. The black skin colour of the Negroes inherits biologically even if they live outside Africa for many generations. The woolly hair is a special characteristic feature of the Negroes. It has been seen that woolly hair is very common among the Negroes, but, on the other hand, it may be present on the heads of one or two Mongoloid people due to individual variation. This new character has been developed in the Mongoloid people, though limited, due to a new gene which has been arisen by mutation. Therefore, in the strict sense, it cannot be said that woolly hair is present among the Negroes and absent in all the other groups. It is better to use the term 'uncommon' in other human groups. Therefore, it indicates that the races are distinguished from each other by the relative commonness of certain inherited characters. The race, therefore, may be defined as populations more or less reproductively isolated from one another which differ amongst themselves in the relative commonness of certain hereditary traits.

But this definition needs discussion regarding the various points. There are certain tribal and community groups who live in partial isolation and under peculiar environmental conditions. For this reason, they have developed certain characteristic physiological traits in which one group

differs from the other. In various earlier literatures the different partially isolated groups of the same community had been recorded as different races which, naturally, added more complexities. The examples of this kind are the various groups of the American Indians. The racial traits are subject to change by mutation, and there are various evidences regarding this. If this is so, then race is not a static group but a dynamic one. The stability of race depends on durability of various genes responsible for various inherited characters. It also depends on the practice of marrying within the racial group. The change in any one of these factors may bring changes in the race.

### RACE CLASSIFICATION

Various authorities at different times have tried to classify the races of the world in the different ways. The want of standard techniques and of definite knowledge about the significance of various racial traits have led the ethnologists to classify the races in diverse ways. The pioneer of race classification was Linnaeus who divided the people inhabiting in the different parts of the world into groups like the following—

*americanus* (American Indian)—Tenacious,  
contented, free ; ruled by custom.

*europaeus*—Light, lively, inventive ;  
ruled by rites.

*asiaticus*—Stern, haughty, stingy ; ruled  
by opinion

*afër* (African)—Cunning, slow, negligent,  
ruled by caprice.

The first classification of mankind, done by Linnaeus in 1738, was based on mental characteristics. Then, in the year 1775, Blumenbach a noted German scientist who, first of all, attempted at the scientific study of man and divided the population of the world into five classes. Each of these classes was termed a 'race', the word first used by a French scientist,



Buffon. Blumenbach studied the human groups on the basis of skin colour and he arrived at the following five races—

- Caucasian or white
- Mongolian or yellow
- Ethiopian or black
- American or red
- Malayan or brown.

In 1878 Hackel established 12 races of mankind. But in 1878 the number increased to 34. In the year 1889, Denniker found 29 races on the basis of hair-form, with skin-colour and nose-shape as subsidiary traits. Keith made a fourfold classification on the basis of skin-colour—white, yellow, brown and black. Von Eickstedt established three main races—Europid, Negrid, and Mongolid—with 18 sub-races, 3 collateral races, 11 collateral sub-races, and 3 intermediate forms. His study was based partly on morphological traits and partly on geographical location. Duckworth studied the population on the basis of cephalic index, prognathism and cranial capacity and made a seven fold classification such as,

- Australian
- African Negro
- Andamanese
- Eurasiatic
- Polynesian
- Greenladiish
- South African.

According to Elliot Smith, the world population can be divided into six groups like the following—

- Australian
- Negro
- Mongol
- Nordic
- Alpine
- Mediterranean

The various schemes employed in racial classification by the

earlier ethnologists were defective in some of their features and, very naturally, they added more complications to a complex problem like race. At the present time racial classifications of man are based on a sorting out of phenotypes. Today attention has been directed to the study of soft parts, to blood group and to the various physico-chemical functions in the body of man. But still now no standard technique has been adopted.

The most recent classification of human race is based on gene frequency method which has been attempted by Boyd in the year 1950. He has classified the people into six races like the following :—

- 1) Early European group (hypothetical)
- 2) European group (Caucasoid)
- 3) African group (Negroid)
- 4) Astatic group (Mongoloid)
- 5) American Indian group
- 6) Australoid group

These groups are characterised by the relative frequencies of eight genes connected with the blood antigens. In the same year three noted American anthropologists, Coon, Garn and Birdsell on the basis largely of the classical criteria of physical type established 30 races. Some of them such as Neo-Hawaiin, South African, and American coloured are of utmost importance because they advocate the theory of races in the making. These 30 races can be grouped into the major six classes of Boyd. In their study the authors have opined that race is not a static factor but it may be called as a stage in the process.

The study of different races can best be made if we are able to acquire thorough knowledge in human genetics. When the tracing of inheritance and distribution of genes, which influence the various human behaviour, will correctly be estimated, the scientific discussion on race elements can be conducted properly.

## RACE FORMATION

A group of organisms who possess the same kind and number of chromosomes, each of which carries the same number of genes in the same arrangement, can be placed under a single species. All the individuals belong to a species, more or less, look alike and they are capable of interbreeding. From this point of view, all men can be grouped in one species, *Homo sapiens*. But, strictly speaking, peoples inhabiting various parts of the world differ fundamentally as regards their physical features. It has already been said that the species *Homo sapiens* have developed certain biological groups. These groups differ in the relative frequencies of some of their genes from each other. These groups have been termed as race. But how these races formed? Certainly, it is an interesting question and it must be answered.

If the gene characteristics of a certain species remain constant, the species will never change and it will continue to reproduce the same kind generations after generations. Therefore, there will be no evolution. But the species change due to the spontaneous changes which suddenly appear in certain genes. This is known as *mutation*. The new mutant gene after its appearance begins to multiply from generations after generations and ultimately they help in developing certain distinctive characteristics in a particular population. Our present knowledge in genetics does not explain satisfactorily the exact process of mutation but the scientists have been able to produce mutation in certain experimental organisms by a particular process. Man is said to be a slow-mutating species in comparison to the others.

The organisms who have been influenced by mutation show bodily differences from other organisms as regards the characters governed by the genes concerned. The new organisms are then have to face severe competition. The competition between the old and new forms are known as *selection*. There are two principle types of selections—*natural* and *artificial*. The traits

which possess greatest survival value under certain conditions will be successful in developing. The advantageous gene multiplies more rapidly than the disadvantageous gene which, it is seen, gradually disappear. Therefore, the organism possessing less adaptive trait in a certain natural condition will be eliminated. This phenomenon is known as *natural selection* as established by Darwin. He also speaks of *sexual selection* which advocates that organisms with new traits that help them in getting mates more than other organisms who have no such traits. In due course the latter organisms will be eliminated due to the monopolization of the formers in reproduction. Sometimes men deliberately select species with certain traits of their liking and allowed to breed and, thereby, they reproduce their own kinds whereas the others are eliminated. This helps in creating new races.

Besides the the above two, another important factor for race formation is the *accidental* or *chance fluctuations* of genes or *genetic drift*. Sometimes the frequency of a gene may increase or decrease suddenly and this does not depend on advantages or disadvantages of environmental conditions. This phenomenon is more common in a smaller group than a larger one. Moreover, migration and mixing of different populations are also responsible for changing the old races and forming the new ones. The formation of new races by migration is very common. In the Hawaiian Islands new races are developing by the mingling of Chinese and European immigrants with the native people. In India, Anglo-Indian group has been developed by the intermixture of Europeans and Indians.

Another important factor for race formation is *isolation*. The isolation may be social or geographical. It is of utmost importance for maintaining the new traits that develop by genetic drift or by selection. During the process of selection of a certain trait the group of people must remain in isolation, otherwise the genetic drift will not be able to produce

distinctive character. The population of the world is distributed in groups. The black skinned people are concentrated in Africa, the white skinned in northern Europe and the yellow-skinned are found mainly in north-east Asia. Between these groups chance of intermarriage is almost absent. At the time of seeking marriage partners a man not only goes to his own geographically isolated group but also his own linguistic, economic and religious groups are taken into consideration. Due to this sort of habit the new gene that arises through mutation or by genetic drift get much opportunity to multiply and thereby develops certain heritable traits in the isolated group. Thus, in due course, a common biological community breaks up into sub-communities and ultimately form new racial groups.

#### IS THERE ANY PURE RACE ?

It has already been seen that the varieties of population in this world have been originated through processes of mutation, selection, genetic drift, migration and isolation. The various divisions of the world's population did not always present. Some parts of the world such as the American continents, Australia, the islands of the South Seas were not populated by man in the very early times. At first man had been a restless animal. He used to move from place to place and this was happened for a pretty long time until the various parts of the world had been populated. During this migration mixing of populations took place which resulted in racial mixtures. It has been going on during the whole historic period. From the fossil record the evidence of the mixture of various stocks in the prehistoric time has also been recorded. At present the various changes in the economic, social and political conditions of the country have speeded up the race mixtures. With the rapid industrilization the country people are moving towards the city where peoples from distant corners have already accumulated. Formerly the marriage circle of the village people was restricted in the neighbouring areas. But after

their immigration in the city marriage partners are being taken from distant groups and, naturally, it results in a very great enlargement of marriage circle. Now-a-days the boys, though negligible in number, are taking girls as their mates from the foreign countries. The development of transport facilities have also played a great role in enlarging the marriage circle. All these factors have increased the opportunities for inbreeding and thereby giving the genes a great mobility. Thus, the relatively homozygous isolated human groups, that existed in the past, have been losing their genetic purity with the march of time.

A question, naturally, comes in our mind. What will happen when a group of people is kept isolated from any immigrant from outside and are allowed to breed amongst themselves? Will it form a pure race? Race is a biological factor and it follows a scientific mechanism. When crosses between Negroes and Whites take place, it apparently seems that all the hybrids take an intermediate hue and it will continue generations after generations. But in fact this is not so. According to Mendel's law the segregation occurs among the hybrids. Due to this fact among the hybrids of intermediate sheds, very dark and very white skin colour also appear. If the hybrids are remain isolated from immigrants and they are allowed to interbred, certainly they will be more homogenous in character but complete uniformity will never appear. Considering all these facts it has been taken for granted that pure races in man never existed in the past and can not exist in the present.

### RACE, NATION AND LINGUISTIC GROUPS

Race must not be confused with nation as is generally done even by the educated people. Race and nation are the two distinct factors. But some authorities find no difference between race and nation. According to Keith, the factors that are responsible for the evolution of nation also plays a great role in the formation of race. But Dr. Piddington has

opposed this and he opines that race and nation fall in two distinct categories. It has already been stated that race is a biological concept. It is governed by a number of genes. On the other hand, nationality is a regional concept and it has got no genetic influence. It is artificial in nature. Any nation, in ancient or in modern times, has not been found composed of a racially homogenous population. But, on the other hand, it comprises a number of different racial elements. Nationality is established by birth in a certain locality or by the regulations for the determination of citizenship of the nation concerned. But the racial traits are established through a complex genetic process.

Sometimes racial groups are also confused with the linguistic groups. Due to this fallacy Lantian race, Aryan race, Semitic race, Dravidian race have come into existence. In the world we find various groups of people speaking various languages and each of these linguistic groups have become more or less isolated from each other. The former workers took these linguistic groups as distinct races; because at that time the study of philology greatly influenced the racial theory. The most important fact of their theories of race on language basis was the Aryanism, popularly known today as the Aryan myth, which spoke the superiority of the Aryan race in all respects. But in reality this theory is baseless. The Aryan-speaking people constitute a number of races. Language is not genetically determined like race. As has already been said, the racial traits are transmitted biologically from parents to the offsprings whereas the linguistic features are transmitted by education and training.

### RACE AND CULTURAL ACTIVITIES

The earlier theories on racial groups advocate that a certain superior race is responsible for the world's great civilization. According to Madison Grant, the Nordic people who possessed great intellect, generosity and many other noble traits, was responsible for the creation of the modern civilization.

The other people did not possess any such noble trait and, therefore, they are inferior to the Nordic. He also opined that any sort of intermixture with the Nordic (great race) would cause a decline in the great civilization. Another scholar, named Count Gobineau, who studied peoples on his travel, was of opinion that civilization rose and fall due to the variations in the races. According to him, pure and advanced races were responsible for the development whereas the intermixture of the races brought declination in the civilization. The Aayan branch of the white race, according to Gobineau, was the pure race who possessed much intelligence to dominate and carry on civilization. The present state of knowledge regarding race show that there is no scientific basis in the thinking of the earlier workers. We have already seen that racial traits are inherited biologically. But the cultural traits are transmitted not biologically but by training and education. The modern knowledge regarding race and intelligence test demonstrates that the racial differences in intelligence do not exist. Most of the scientists are of opinion that the factors like personality, intelligence etc. are greatly, if not wholly, determined by social environment. Therefore, it is futile to say that a particular race is superior in intellect and is the creator of world's civilization. The earlier workers were always biased in favour of one race and used to try to show the inferiority of others.

The historical evidence does not support the view that one homogenous racial group is responsible for civilization. Madison Grant did not think for a while that well developed civilization flourished in Sumer, Egypt and India when the predecessors of his Nordic race were shaping the crude stones in order to use those in hunting purposes. During 3000 B.C. on the banks of the rivers Indus in India, the Nile in Egypt, and the Tigris and Euphrates in Mesopotamia the human life reached at a level of highest luxury. They had invented the art of agriculture and domestication of animals. They had various metal tools, system of writing, religious beliefs and ideas, planned city life



with elaborate drainage system and various other factors for happy living. From the above and other centres civilization diffused to various parts of the world. None of these early centres of civilization show the evidence of completely homogeneous type of people. On the other hand, it is seen that, from time immemorial the great centres of civilization have crowded with people of diverse racial groups. Considering the whole fact it is seen that the Nordic hypothesis is nothing but a myth.

### RACISM—A DANGEROUS MYTH

The term racism is generally used to designate those popular fallacies which support the belief in the superiority of some and in the inferiority of other races. This sort of ideas have been developed in the mind of the people due to multiple reasons. The earlier scholars of different nationalities used to divide the mankind into the higher and lower categories according to their own likings. The idea of higher and lower group, as established by those scholars, had created a great role in the formation of racial prejudice. The pseudo-science that has developed round race has been causing various injurious effect on human life from time immemorial.

The Greek scholars of those days were in habit of describing mankind in two groups—the civilised and the barbarians. The latter division generally included all the non-Greek. Aristotle pointed out that some men were born to be free and the others to be slaves. Later on developed the idea of Roman superiority. According to the Roman writers, the Roman ideas of government were superior to all the other in various aspects. In the Middle Age, theologian scholars pointed out three great groups as the Christians, the infidels, and the heathens. Then, in due course, Nordic and Aryan hypotheses had been presented by the different authorities.

In course of time there developed the idea of racism, the most dangerous effect of which had been found during the Nazi regime. The Nazis rose to power in Germany during the 1930's.

They used to think that their neighbours were biologically degraded and that was why they wanted to abolish the entire Jewish population. They thought that by killing the Jews and other "inferior races" the world would be benefited. Due to the calculated murder of the Nazis 6 million jews were abolished. This ethnic struggle surpassed all other forms of cruelty and ill treatment.

At the present time race conflicts have become too common in America and these have created a great problem in the life of the Americans. The race problem of the present days have been resulted due to migration and contacts of peoples. It has developed into a peculiar disease of human society. Social scientists and other scientific personnel have already tried to draw the attention of the people into the fallacy on which the theory of racism is based. The scientific evaluation of race has already been done and it has been shown that the race prejudice is nothing but stereotyped opinions and attitudes that are held by one group of people about the other. Various factors such as imperialism, the efforts to dominate in power relationship, competition for land, job, business etc., and widespread ignorance and poverty have jointly intensified the ethnic problem. Race problems have been and are being discussed by the different scholars and general public and all of them are trying to minimise it. Prof. Ashley-Montagu, speaking about the racism of America, has remarked, 'we in the United States have every hope of eradicating the contagion of 'racism' from our body politic, but hope alone will not suffice. We must act, and in order to do so intelligently, we must know what this disease is and how it may best be dealt with.'

It is not possible to attempt for a solution of the racial problem without the current knowledge of the laws of heredity. Biological evaluation of race reveals the following facts.

- (a) No race is superior. There is no race, at present, which is more advanced than the other as regards its physical features.
- (b) Race is a purely biological concept and, therefore, it is futile to make an attempt for relating it with language, culture and nationality.

(c) The cultural activities of a group of people have got no relation to their racial set up.

(d) No scientific investigation states that racial differences in intelligence exist.

There is no doubt that all of the above facts are correct as they are based on scientific enquiry. Therefore, it is seen that, in reality, the idea of racism has got no connection with the term which we call race in the proper biological sense. The opinions and attitudes of the people regarding race prejudice are all false. It is a matter of great regret that the people of different nationalities have been and are still, in some cases, supporting this purely false idea and thereby creating unhappy situations in their daily life. Racism has got no scientific evidence; it is a myth, and sometimes it brings calamity in human life.

## THE CRITERIA OF RACE

*Before starting for any scientific investigation a scientist should be well-acquainted with the basic principles of his tools of study. In classifying the people of the world several characters are used as the tools the nature of which should be studied scientifically before proceeding for the establishment of the physical groupings of mankind. Are all the criteria are reliable ? Do they help the investigator in achieving the success without difficulty ?*

In order to classify the people of the world into various groups or races a number of external and internal physical characteristics are used as the racial criteria. Earlier workers used to rely on one or other single characteristic. But it should always be kept in mind that no single character can be taken as a reliable criterion for racial discrimination. The racial criteria that are being used now-a-days have to face various criticism regarding their validity. The recent development of the science of human genetics have unfolded various mysteries regarding the different factors which govern the bodily characteristics of man. Due to the presence of the recessive genes in the body the phenotypic or external characteristics of a person may not tally with the genotypic characters. It is scientific to select the genotypic characters as racial criteria. These should be hereditary and non-adaptive.

Almost all the present criteria ( except the blood group ) for racial classification are phenotypic in nature. There is a reason

behind it. Formerly the workers in this particular line believed that the characters like the hair form, skin colour, nose form etc. are based on hereditary factors. But in reality they are not so. These physical characteristics are subjected to change on various outside influences e.g. environment, food habit and the like. Therefore, we must be careful while using these criteria in racial classification. It would be better and at the same time scientific if we shall try to analyse these criteria genotypically. The day when it would be possible to establish a genotypic relation on these features, the whole matter will face a revolutionary change.

Before going to discuss the various racial criteria in detail, it is better to mention a few points that are to be kept in mind in studying the races of the world.

(a) It is not wise to group the people in a definite race based on the study of a single trait.

(b) Importance should be given on the genotypic characters while studying the racial criteria.

(c) During racial survey adequate number of people should be studied in order to avoid inaccuracy.

(d) Various features of the racial criteria depend on the age and sex of the individuals. It is, therefore, scientific to have a comparison test among the individuals of the same age and sex.

## 1. SKIN COLOUR

In the population of the world we find various shades on the skin which differ one group from the other. The skin colour has been taken as one of the distinguishing characteristics in the study of the race, but there is a lot of difficulties in establishing this criterion as a reliable source of study. The people of the world can be classified broadly into three groups on the basis of skin colour.

1. **Leucoderms or White skinned people**—The best example of this group are the Europeans. But there are other groups of people e. g. Western Asiatics, North Africans, Polynesians etc. who possess skin colour which varies from pinkish white to light brown.

2. **Xanthoderms or Yellow skinned people**—The best example of this group are the Asiatic Mongoloids. Armenoids, Hottentots and Bushmen also exhibit yellowish tinge in the colour of their skin.

3. **Melanoderms or Black skinned people**—The Negroes are the fittest example of this group.

The colour of the skin depends on the amount of pigments in the deeper layer of the epidermis. The skin is composed of two main layers—the *epidermis* and the *dermis*. There is no blood supply in the former layer. In this layer the skin pigments or *melanin* are found. These are nothing but very dark brown or black granules. The colour of the pigment varies from yellow to black. But it is to be noted that the skin colour is dependent on the amount of the granules present in the epidermis and not on their colour.

The colour of the skin has a protective value. The black skin helps its possessor to withstand the scorching rays of the sun. On the other hand, in the cold climate white skin is of greatest value as white is the best colour for keeping in the heat of the body. In the tropical regions we are often met with the people with black skin. Continuous exposure to the sun darkens the skin colour. However, it is futile to establish any direct relationship between the environmental conditions and the skin colour. It is true that most dark skinned people are seen in the tropical regions. But, on the other hand, we see the people with dark skin e. g. the Tasmanians living in the temperate areas. The American Indians living in the tropical regions of America possess less darker skin colour than what it should be. It has been found that the ultra-violet rays of the sun stimulates the skin pigment to multiply and thereby the skin colour turns blacky. But this influence ceases when the direct sunlight is out of from the body of the person concerned.

The female population in a certain group of people possess lighter skin in comparison to the males. This has resulted due to the fact that the skin of the female contain less blood and melanin than that of the male. Pregnant women's skin, specially certain parts, become darker due to overpigmentation. This

overpigmentation is caused due to the excess of copper in the blood. There are also cases of pathological pigmentation of the skin the causes of which are various. The skin may suffer from Addison's disease in which the skin takes bronze colour, yellow, brown and black. The complete absence of pigment or the cases of albinism are also met with amongst the population of the various parts of the world. In a complete albino we find the total absence of pigment not only in the skin and hair but in the eyes and other organs also. It is a pathological case. The albinism may be partial also. In this case the body of the person concerned possesses unpigmented patches at the different places. The eyes may be blue in colour.

The detailed information regarding the inheritance of skin colour in man have not yet been possible to gather. Some suggest that the skin colour is the effect of different degrees of pigment intensity that is controlled by the action of many genes. There are no fundamental difference in the kinds of genes which exhibit different shades in the different groups of people. The range of colour in man depends on the frequencies of the same kinds of genes. It is said that many genes are involved in the formation of skin colour, each of which produces a small effect without dominance.

## 2. HAIR

Hair may be regarded as one of the most important characters in racial discrimination. This criterion was employed for the classification of human races as far back as 1820. The character of hair provides a beautiful basis for the primary classification of the races of the world. Hair grows abundantly on the head of human being and we do not find any race in the world who possess inherent baldness. In order to study the hair following characters should be noted—form, colour, texture, quantity, cross-section, and hair whorl.

### (1) Hair Form—

According to the forms, the hair can be divided into three broad groups—

(i) *Leiotrichy* or straight hair—

This type of hair is found among the Mongoloid people. It is again sub-divided into three types—

(a) Stretched—This type is thick, coarse and straight.

(b) Smooth—This type is comparatively thinner and soft.

(c) Flat wavy—This type of hair has a tendency to form waves with largest radius.

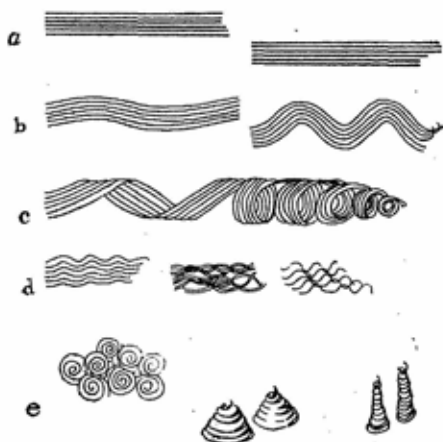
(ii) *Cymotrichy* or wavy hair—

This type of hair is most widely distributed amongst the people of Western Asia, some parts of Africa and Europe. It may be sub-divided into the following types—

(a) Broad wavy—This type possesses waves with smaller radius and they are found on one plane only.

(b) Narrow wavy—This type possesses waves with strong curvatures; the waves lie in one plane.

(c) *Curly*—The spirals of this type are broad and the curvatures do not lie in one plane only.



(a) Straight hair, (b) Wavy hair, (c) Curly hair (d) Kinky hair, (e) Woolly hair (Peppercorn type)



(iii) *Ulotrichy* or woolly hair—

This type of hair is found among the Negroes, Andamanese, Bushmen, Papuans, Melanesians etc. This is sub-divided into the following—

(a) *Frizzly*—This type possesses waves which are short and deep.

(b) *Loose Frizzles*—The spirals of this type of hair are circular and flat.

(c) *Thick Frizzles*—This type is more or less like the above form but is thickly set.

(d) *Filfil*—This type of hair are heavily rolled and popularly known as peppercorn.

It has been seen that there are some relationship between the hair form and the climatic conditions. The straight hair is found in dry and cold climate. Moist and warm climate is sometime said to be responsible for woolly hair, as most of the people, we see, possess this type of hair who live in such region. It should be noted in this connection that there are certain groups of people who live in moist tropical regions but possess straight hair. The American Indian groups of the Amazon basin and the Malays of Java, Borneo, and Malaya can be taken as the best example for this. The hair form, on the whole, is less affected by environmental conditions; it is most probable that the hair form is wholly a non-adaptive feature.

(2) *Colour* :—

In the population of the world we find various shades of colour. The colour of the hair is due to some brown or black granular and non-granular pigments. The hair-shaft consists of three parts—the thin and unpigmented outer layer, the *cortex*, and the *medulla* or *pith*. The hair pigments are commonly found in the cortex, but in some cases these are also present in the medulla. Besides these black pigments a red-gold pigment is found in the hair. The grayness of the hair is resulted from the reflection of light from the unpigmented cortex and the medullary spaces of the hair shaft. During the old age the medullary spaces of the hair increase; this

fact and the absorption of some pigments in the shaft jointly give the hair a grey colour.

Hair colour is not affected remarkably by the environmental conditions. Dark hair is very common. In the case of the Mediterraneans it is seen that the colour of the hair is darker while that of the Northern Europeans ranges from light brown to reddish. In Africa and Melanesia there are some Negro population who possess yellow hair. These may be cases of partial albino or they have artificially changed the colour of their hair by bleaching these with lime, urine and other chemicals. The Oceanic Negroids mostly possess dark red hair while among the Native Australians the children possess reddish hair which become dark brown when they attain maturity. The cases of blondness is found only among the people living in Baltic area of Europe.

### (3) Texture :—

As regards texture the hair can be divided into three groups :—(a) Coarse, (b) Medium, (c) Fine. In a preliminary study of the hair textures these may be found out by rubbing the hairs with the help of the fingers, But in order to get a correct result the hair should be studied scientifically. Garn has studied the human head hair shaft and he has come to the conclusion that the thickness of the shaft varies between  $25\ \mu$  and  $125\ \mu$ . He has also attempted an arbitrary classification of the head hair of man which has been reproduced below.

Fine hair	— $56\ \mu$
Medium hair	— $57\ \mu$ — $84\ \mu$
Coarse hair	— $85\ \mu$

### (4) Quantity :—

The quantity of the head hair can be classified like the following :—

(a) Scanty, (b) Medium, (c) Thick, (d) Very thick and (e) Rich

These can be determined by visual observation. In studying the hair characteristics the cases of body hair, bearded and moustache should also be taken into account.

**(5) Cross-section :—**

In a scientific study of the hair the cross-sections should also be taken into consideration. As regards cross-section the human head hair can be divided into two types—(a) Circular, and (b) Oval. The former type is found mainly among the Mongolian people and the latter is the characteristic of the Negroids and the other types.

However, the importance of the cross-section of human head hair in racial discrimination is very little as different types of cross-section may be found in a single individual.

**(6) Hair whorl :—**

The whorls of the hair on the occiput of the head should be taken as one of the factors in studying the nature of the hair of an individual. There are two types of whorls—(a) Clockwise, and (b) Anti-clockwise. Generally a person possesses one whorl but in some cases two and even three, though rare, such whorls may occur.

**3. STATURE**

Stature yields unsatisfactory racial data as it is affected greatly by the environmental conditions. The stature of an adult male is generally taken as the measure in racial classification. Average stature for modern man is about 5'6". The increase of stature begins right from the embryonic stage and continues upto the attainment of puberty. According to Quetelet, the stature of a man at birth is 50 cm ; at 5 years of age he becomes about 1 metre in height and at 15 years he attains a height of about 1.50 metre. When the man reaches at the step of 19 years, he requires only 15 mm. more to complete his full height, which generally takes place at the age of 30. Then from 50 to 60 years of age the stature of a man begins to decrease and at 90 years it suffers a total decrease of 7 mm.

Regarding stature the normal range for male is from 130 cm. to 200 cm. and for females it varies between 120 cm. and 187 cm. The human beings can be classed roughly into five

major groups according to the stature which has been given below.

	<i>Male</i>	<i>Female</i>
Very short	... 150.0 cm.	—140.0 cm.
Short	...151.0 cm. — 160.0 cm.	141.0 cm — 150.0 cm.
Medium	...161.0 cm. — 170.0 cm.	151.0 cm — 159.0 cm.
Tall	...171.0 cm. — 179.0 cm.	160.0 cm — 167.0 cm.
Very tall	...180.0 cm. +	168.0 cm. +

South Patagonia has presented the tallest type of men and the shortest people come from Africa (Negrillos) and Asia (Negritos). The stature is subjected internally to a wide interplay of genes and externally to a number of environmental circumstances. Stature, therefore, is dependent on two factors—idiotypical (hereditary) and paratypical (environmental). According to the physiologists, the stature of a person depends on some internal secretions of the thymus, pituitary and other glands. Stature is probably much affected by the environmental conditions, particularly in the dietetic pattern. Earlier scientist like M. Gould showed that the stature of American sailors is lesser than that of the soldiers of the same race, who were better fed. Children who suffer from malnutrition fail to attain requisite height. The study of the Russian people before and during the three-year period of famine has given a wonderful evidence in supporting the fact that the stature is greatly affected by malnutrition. Ivanovsky's study reveals that the Great Russian males and females suffered an average decrease of 4.7 cm. and 3.5 cm. respectively during the period of famine. The other Russian people suffered loss in stature from 3.8 cm. to 6.1 cm. in males and 3.6 cm. to 4.8 cm. in females. But when the favourable conditions regarding the diet came all the people regained their lost stature within a very short period. Martin has also shown that stature of the German youth who suffered from malnutrition during the First World War and Post War period reduced greatly.

It is also seen from the various research works of the different authorities in this particular line that the stature

depends on the differences in occupation, social class, hygienic and other environmental conditions. Drs. Bertrand, Perny, Mouille showed many poor and rich countries side by side with shorter and taller population respectively. Quetlet found that in Belgium the town people are taller than the country folk. According to Torday, the stature depends on regular life, sunshine and free air. The Negrillos inhabit in a dark and thick forest. Torday found that the Negrillos who live in a more open place were taller. But a stock of them who migrated to the opposite side where there were thick forest, and less sunshine suffered the loss in stature. In India, Thurston has found that the domesticated Kanikars are taller than those of the jungles. According to Sarkar, the plane Males exhibit an increase in stature when they are compared with the Hill Males.

However, it is seen that the environmental and dietetic factors are, in no way, solely responsible for the change in the stature. Many of the tallest people of the world come from the region where malnutrition is common feature. Martin collected the data of 14 African tribes whose statures ranged from 170 cm. to 181.7 cm. It is remarkable that no one of these tribes live in a country where food is easily available. If we consider the cases of the Indians of Tierra del Fuego in South America who are notable for the tall stature, we must come to the conclusion that the stature does not depend directly on the nutritional factor. Because the land where these people live is unfertile and, therefore, the living condition is too low.

On the whole, the stature, though it is influenced by the environmental conditions is mainly a hereditary factor. Davenport has shown that the tall stature is recessive in character and certain growth repressing factors, that are present in the short families, are dominant over their absence. Yet the stature cannot be taken as a responsible racial criterion as we find a widely individual variation in stature in every group which causes a great disturbance. As for instance, Hrdlicka has stated that the average stature of the Pueblo Indians is

164.5 cm. ; but their individual variation ranges from 148.2 cm. to 182.3 cm.

The scales of stature employed by the different scientists are given below :—

*The scale used by Haddon*

Pygmy	...	—148.0 cm.
Short	...148.0 cm.	—158.0 cm.
Medium	...158.0 cm.	—168.0 cm.
Tall	...168.0 cm.	—172.0 cm.
Very tall	...172.0 cm.	+

*The scale used by Martin*

Pygmy	...	—129.9 cm.
Very short	...130.0 cm.	—149.9 cm.
Short	...150.0 cm.	—159.9 cm.
Below medium	...160.0 cm.	—163.9 cm.
Medium	...164.0 cm.	—166.9 cm.
Above medium	...167.0 cm.	—169.9 cm.
Tall	...170.0 cm.	—179.9 cm.
Very tall	...180.0 cm.	—199.9 cm.
Giant	...200.0 cm.	+

#### 4. HEAD FORM

The form of the head is considered as one of the most valuable characters in racial discrimination. In this part of the body are found many distinctive inherited variations and, therefore, it presents many important features. On examining the shape of the head from the top it is seen that the people possess various forms of head. Some are oblong, some are elliptical, long, oval, pentagonal etc. The anthropologists have tried to classify the heads of the people of the world on the basis of scientific measurements. The measurement of the head was taken to be the more fashionable and reliable characteristic. The Frankfurt Congress, which was held as early as 1882, first of all standardized the different measurements

on the head and the skull. The cephalic index which is still used in the study of the head form is of nineteenth-century origin.

An eminent Swedish anthropologist Anders Retzius, first of all, definitely established the principle of observing the proportion of the breadth to the length of the head in classifying the human races. The cephalic index can be illustrated as follow :—

$$\frac{\text{Breadth of the Head} \times 100}{\text{Length of the Head.}}$$

The length and breadth of the head, are to be found out by means of Martin's calipers and then the breadth is multiplied by 100 and is divided by the length. The cephalic index indicates what percentage the width of the head is in relation to the length of it. When the measurement is taken on the skull it is known as cranial index. With the help of these indices the skulls have been grouped by Paul Broca who can be called as the father of the craniological studies.

*Broca's classification*

Dolichocephalic	...	— 75.00
Sub-dolichocephalic	... 75.01	— 77.77
Mesaticephalic	... 77.78	— 80.00
Sub-brachycephalic	... 80.01	— 83.33
Brachycephalic	... 83.34	+

But Broca's study is based on the measurements on the skeletal skull and, therefore, it leads to some difficulties when the measurements are taken on the living subjects. The thickness of the skin and the tissues on the skull will naturally reach at a different set of values from those obtained from the skeletal skull. Joseph Deniker, who is one of the pioneers in the establishment of physical anthropology as a real science, has given a scale of measurements on the heads of living subjects.

Hyper-dolichocephalic ...		-75.90
Dolichocephalic ...	76	-77
Sub-dolichocephalic ...	78	-79
Mesaticephalic ...	80	-81
Sub-brachycephalic ...	82	-83
Brachycephalic ...	84	-85
Hyper brachycephalic ...	86	+

The height of the head is also to be taken in studying the length-height and breadth-height indices. The height is generally measured from the ear opening to the highest point on the top of the skull. It is very difficult to get an accurate head height measurement on the living. Moreover it is subjected to individual variations. The distribution of head height among modern people is so limited and at the same time defective that it is very difficult to employ this as a racial criterion. According to the length-height and breadth-height indices, the head can be grouped like the following as are given by Martin.

$$\text{Length-Height index} = \frac{\text{Auricular Height of the Head} \times 100}{\text{Head Length,}}$$

Chamaeocephal ...		-57.6
Orthocephal ...	57.7	-62.5
Hypsicephal ...	62.6	+

$$\text{Breadth-Height index} = \frac{\text{Auricular Height of the Head} \times 100}{\text{Head Breadth}}$$

Tapeinocephal ...		-78.9
Metriocephal ...	79.0	-84.9
Acrocephal ...	85.0	+

The height of head varies among the modern races of the world. The Australians, for instance, possess lower heads than the other people. The prehistoric men possessed lower crania. There is a relation between the head height and the size of the frontal part of the brain which is responsible for the development of intelligence. Therefore, it may be concluded that the low-headed prehistoric men possessed smaller fore-brain and thereby, they were less intellectual than the modern man.

The cephalic index as a racial criterion has to face a number of challenges from the different authorities so far its validity is



concerned. The anthropometric studies of Franz Boas reveal the fact that the cephalic indices of the children of immigrants to the United States vary to some extent from those of their parents. In the United States the children of the round-headed Eastern European Jews possess absolutely longer and relatively narrower heads than those of their parents; while the long headed Italian immigrants produced broad-headed children. These facts have not yet clearly been explained. Environmental factors may act to some extent in these cases. The migration of a group of people from Europe must have brought some changes in the living conditions, nutritional habit, and occupational patterns which jointly have changed some of their physical features. But this fact has not been supported by all. According to Boas, the variation of the head form in the children of immigrant parentage is due to the nature of marriage contract in the United States. Boas studied the immigrants who came largely from eastern and southern Europe. While in Europe these people used to confine themselves in the same locality during the settlement of marriages. But in the United States the people of different localities came in close contact and settled marriages. Due to the interbreed between the individuals of different localities variations in physical features automatically occur.

Prof. Ivanovsky's study amongst the people of Southern Russia reveal the fact that malnutrition also exert some influences on the cephalic index. The cephalic index may also be modified by some artificial methods practised by some American Indian tribal folk. They still bind the skulls of infants between boards, in order to get a conical or flat-shaped cranium.

Palaeontological data from the various parts of Europe suggest that the people in the prehistoric period possessed dolichocephalic heads. The evidence of first brachycephals occurred in the Upper Palaeolithic Age of Europe. Gradually the brachycephalic heads increased and these ultimately, save a few places, covered the whole of the country. This gradual brachycephalisation has been described by R. B. Dixon as an universal phenomenon as he has found that the long-headed people had been

replaced by the round-heads in almost all corners of world. The head form ranges amongst the three primary races—Negroid, Caucasoid and Mongoloid,—from the dolichocephaly to brachycephaly through mesocephaly. In all the three of these a mutation towards brachycephaly must have occurred. It is to be noted that in Negroids and in Mongoloids the brachycephalic and dolichocephalic elements respectively are rare. In the caucasoid race no forms of head is seen to be very much dominant numerically.

However, the cranial index should be given secondary importance in racial classification. It is seen that the cranial index is more or less stable during the life of the individual, and this feature is hereditarily determined. Yet it can not be established with certainty that a dolichocephalic has been descended from a continuous line of dolichocephalic ancestors. Sometimes brachycephalic parents may produce dolichocephalic offsprings. Therefore, the cranial index should be used in association with the several other reliable criteria in racial discrimination.

## 5. FACE FORM

The face of man possesses many distinguishing characteristics. In recognizing a person we generally look at his face. Face may be of different shapes e. g. oval, round, square, but actual shape of the face can best be understood by scientific measurements. The length of the face is measured by the instrument known as sliding calipers. Face length is to be measured from the nasion to the lowest point in the middle line of the lower jaw; and the breadth, which is to be measured by means of the spreading calipers, is the maximum distance between the two directly opposite points on the malar. Then the facial index is to be found out by dividing the length of the face by its width and multiplying the quotient by 100.

$$\text{Facial Index} = \frac{\text{Morphological Facial Length} \times 100}{\text{Bizygomatic Breadth..}}$$

The facial indices have been classified as follow :—

Hyper euryprosopic	...	— 78.9
Euryprosopic	...	79.0 — 83.9

Mesoprosopic	...	84.0	-87.9
Leptoprosopic	...	88.0	-92.9
Hyper leptoprosopic	...	93.0	+

There is a harmonic relation between the face and the head. A long face is generally associated with long head, while a brachycephal has a broad face. But in some cases exceptions are noticed in this arrangement. This condition is known as disharmonic. Among the Armenoids it is seen that they possess long and relatively narrow faces with absolutely short and relatively broad heads. The condition of long head with broad face is generally met with the Eskimos. The Cro-magnon people also possessed this type of disharmonic face.

In studying the face another feature—*prognathism*—is to be taken into consideration. Prognathism has been understood to mean the elongation and prominence or obliquity of the jaw which is common among the black races of Africa and Oceania. When the face does not show any trace of protrusion it is known as *orthognathous*. The forward projection of the face may be found out by studying the angle made by line going through the nasion and the alveolar point in Frankfurt plane. If the angle, thus formed, is less than  $90^\circ$ , the face will be termed as prognathous. Otherwise, it should be called as orthognathous. Sometimes the alveolar regions of the upper and the lower jaw projects forward which is known as alveolar prognathism. The forward projection of the facial region is termed as the facial prognathism. Almost all the apes and monkeys exhibit both kinds of prognathism. Most of the Mongoloid people and some White races possess slight alveolar prognathism. Facial prognathism is almost absent in them. It has been seen that when the prognathous and orthognathous individuals are interbred the facial projection begins to disappear. The modern people are generally orthognathous; only a few section of them show marked prognathism. As it is seen that the prognathism disappears in the offsprings of prognathous and orthognathous parents, therefore this feature has got little importance in racial discrimination. It may be applied as a tool in studying racial history.

The facial index also has got a limited scope in racial classification. The length and breadth of face vary with the development of age. The eruption of teeth, elongation of the jaws, wear of crowns, loss of teeth etc. cause a variation in the facial index during the different periods of man's life. Moreover the continuous and vigorous use of the masticatory apparatus generally broaden the jaws. The hereditary nature of the facial characteristics has not yet been clearly understood and also it is not known how many pairs of factors are responsible for the facial length and breadth. Therefore, it is very difficult to use this factor as a racial criterion. However, it may be used along with the other reliable factors.

## 6. NOSE

The nose presents a number of interesting features. It should be studied on the following points :—

### (1) The Nasal Index

The nasal index indicates what percentage the width of the nose is in relation to its length. On the skeleton the length of the nose is measured from the nasion to a point just at the base of the nasal spine. The width means the maximum distance on the nasal opening in the skull. But on the living subject the length of the nose is to be taken from the nasion to the point where the nasal septum touches the upper lip. The greatest distance between the two fleshy wings (in natural condition) of the nose indicates the nasal width. The nasal index may be expressed like the following :—

$$\text{Nasal Index} = \frac{\text{Nasal Breadth} \times 100}{\text{Nasal Length}}$$

Formerly much importance was given on the nasal index in classifying the people of the world into the different races. M. Broca used to consider that the nasal index as one of the best factors in distinguishing the various races of mankind. The nasal indices can be grouped like the following :—

#### *On Skeleton*

Leptorrhine	...	—47.9
Mesorrhine	... 48.0	—52.9
Platyrrhine	... 53.0	+

*On the Living Subject*

Leptorrhine	...	—70.0
Mesorrhine—	... 71.0	—84.9
Platyrrhine—	... 85.0	—99.9
Ultra-platyrrhine	... 100.0	+ . . .

The nose of a Negro is broad and short. The Mongoloid, on the other hand, possess short and moderately broad nose. Their nasal index is frequently mesorrhine. The Whites of Europe, Asia and North Africa exhibit leptorrhine type of nose; whereas the native Australians possess clearly marked platyrrhine nose.

It has been taken for granted that the nasal index is dependant on environmental conditions. Broad nose and wide nasal apertures are generally met among the people who live in hot and moist condition, whereas the longer and narrower noses are the characteristics of the people inhabiting in regions of cold and dry climate. The narrower and longer nose are more helpful in warming the cold air before it goes to the lungs. It also reduces the volume of cold air that reaches the lungs. The broad-nosed people living in warmer climate can inhale with their broad nostrils great amount of warm and moist air without giving any stress of the linings of the respiratory organs.

Sometimes it is seen that correlation between the nasal index and the climatic condition is less prominent. In the world in population it is found that a number of leptorrhines are living tropical areas. The natives of Siberia and certain American Indian tribes live in arctic climates with mesorrhine nose. These irregularities have been explained by the fact of immigration and the change of population. As for example, India was invaded by the leptorrhine Aryan-speakers sometimes in the past. This is why this country exhibits groups of narrow-nosed people living in temperate zones. It is true that the climatic conditions have some effect on the nose form, but it should be noted that the process of modifications in this line is very slow.

Accurate measurement of the nasal length can not be taken in any case due to the disturbances caused by the soft tissues in finding out the nasion point. There is a difficulty in exact comparison between the various scales of nasal index of the skull and the living subject. Moreover, the data, so far collected, in studying the hereditary nature of the different parts of the nose are too insufficient to come to any right-conclusion. Considering all these technical difficulties it is not wise to attach much importance on the nose form as a racial criterion.

(2) Nasal root, bridge, etc.

The nasal root is seen at the junction of the nasal bones with the frontal bone of the skull. It has a depression which may be low, medium, or deep. The skeleton of the nose consists of two more or less rectangular pieces of bone. These two bones form an angle along one of their long sides which constitute the the nasal bridge. The nasal bridge may be low, medium, or high. The profile view of the bridge may be straight, concave, convex or concavo-convex. Low and broad nasal bridges and roots were in common among the earlier and primitive human groups. Among some of the African tribes these characteristics are still seen though less marked. The Europeans possess high and narrow nasal root and bridges while among the people of eastern Asia intermediate forms are met with.

There are other minor features which should also be taken into consideration while studying the nose. The tip of the nose may be thick or thin, rounded or pointed; the septum may be horizontal, directed upward or directed downward. It may also be straight, concave or convex in profile view. The wings of the nose may be thin or pinched, or wide or flaring. The nostrils may be oval or rounded so far as the diameter is concerned.

Among the different races of the world certain typical nasal features are met with. The nose of a Negro is provided with a slightly depressed root which is low and broad. The tip of the nose is thick and usually turned upward. The septum is thick

and directed upward, and the wings are very thick and flaring. On the whole, the nose is very short and broad at the tip and wings. The nose of the Australian differs from that of the Negro in its root which is more deeply depressed, the tip is large and the wing is more spreaded. In the Mongoloid nose the root is much lower than that of the Negro. The bridge of the nose is also much lower and much narrower. The tip is not so swollen and the wings are thinner than the Negro nose. The nose of the Caucasoid is characterised by the highest development of the bridge and root. The tip is elongated and the nasal wings are compressed. However, the data regarding the hereditary nature of the nose form and its distribution among the world population are very limited and, therefore, it is difficult to apply this criterion in racial discrimination.

## 7. EYE

The eyes also have got some characteristic features which sometimes help in discriminating the races of man. While studying an eye the following points are to be consulted—eye fold, eye slits, and eye colour. The most distinctive type of an eye is found among the Asiatic people, such as the Mongols, the Chinese, etc. In these eyes the palpebral fissure is oblique, the outer angle of the eye is higher than the inner angle. The eye opening possesses its external corner elevated so that it slants upward and downward.

The corner of the opening portion of the eye is called *canthus* which may be of two types—inner and outer. In certain groups of people of the world, it is seen, that a fold of skin hangs over the free edge of the whole upper lid and covers it thoroughly. It extends from the outer to the inner corners of the eyes. As this phenomenon is found with a high frequency among the Mongolian people, it is generally known as *Mongoloid fold*.

The most common variety of fold is internal or complete epicanthic fold in which the fold conceals the free edge of the

inner angle of the eye. Sometimes the fold starts on the middle portion of the upper eyelid and extends below the outer portion of the lid and ultimately covers the outer corner of the eye. This is known as external epicanthic fold. Similarly the fold may cover only the central part of the edge of the eyelid. This is known as median fold.

As has already been said that inner epicanthic fold or Mongoloid fold is the characteristic feature of Mongoloid people and of the people with Mongoloid admixture. A non-Mongoloid eye is straight and wide. Among the old people of different races median or external epicanthic fold may be found which has resulted due to the loss of elasticity in their skin.

The colour of the eye is also to be studied carefully. Eye colour is dependent on the amount of pigment present in the front and back part of the iris. It has a double layer of pigment cells at the back. The front layer may or may not be pigmented. The colour of eye shows a wide range of variation. It may vary from blue through hazel to light brown, dark brown or black.

The colour of the eye is dependent on two factors—(a) the amount of pigment present in the back layers of the iris and, (b) the amount present in the front layers. If in an iris the pigment is present only in the back side, the colour of the eye will be blue. If the pigment is found in a good amount in both the sides, the eyes will take brown or black colour. Also the colour depends on the thickness of the iris. It may be proper to state that the different colour of the eye are due to the different reflective qualities of the brown pigment present. There are no blue or green coloured pigments. In the case of the albinos it is found that due to the absence of pigments in all parts of the body including the iris, the colour of the eye becomes pinkish. This is due to the red colour of the blood vessels that are seen through the iris from outside.



## 8. BLOOD GROUPS

The study of the blood groups has helped the ethnologists in changing their angle of vision in looking at the races of mankind. Each constituent of the blood is genetically determined and this factor is being utilised by the modern scientists as an important and reliable racial criterion. Today this criterion is extensively used in studying the racial groups, racial movements, migration etc., the details of which will be discussed in the following chapter.

## 15

# SEROLOGY AND RACE

*The study of blood is of utmost importance. The various constituents that form the blood of an individual are genetically determined. The knowledge about the inheritance of these elements is essential as it is related to blood transfusion and various other essential matters of human life. Does serology help in tracing the relationship of ethnic groups to one another and in classifying the mankind in the different races ?*

The value of serology or the study of blood has already been recognised throughout the scientific world as the most important and essential tool in ethnological studies. The study of 'Blood groups' is also essential at the time of blood transfusion. The blood of a healthy person may be transmitted to a person who is ill or has lost a good quantity of blood due to some sort of accident, but the transmission should be made in a specified way. About 50 years ago the exact causes of failures and successes in blood transfusion had been discovered ; and it was seen that the presence or absence of certain substances in the red blood cells were responsible for the said successes or failures. Blood groups of both the donors and the recipient should be known earlier, otherwise the blood transfusion may end in a pathetic result.

The blood of vertebrates consists of fluid, the plasma in which there are suspended various kinds of cells or cell-like bodies known as corpuscles. Blood corpuscles are of two types—(1) *Leucocytes* or white blood corpuscles (W. B. C.) and (2)

*Erythrocyte* or Red blood corpuscles (R. B. C.) The former ones are nucleated and lack haemoglobin, whereas the later ones are non-nucleated and due to the presence of haemoglobin in them they look red. The main function of these R. B. C. is to carry oxygen from the lungs to the various parts of the body. The W. B. C. help in destroying the foreign invaders such as various types of harmful bacteriae which enter into the plasma from outside.

It is seen that if a certain quantity of blood is taken out of the body of a man and is allowed to stand, it tends to coagulate. This is known as clotting of blood. In the blood of man there are three principal proteins—(1) *serum albumin* (2) *serum globulin* and (3) *Fibrinogen*. The fibrinogen has got some special interest because of the fact that in certain circumstances it creates certain fibrous substances known as fibrin which attacks the various blood cells and ultimately give rise to the 'clotting of blood'. After the formation of fibrin a pale transparent yellowish fluid oozes out of the plasma which is called the *serum*. It can simply be written as follows :—

#### Plasma—Fibrin = Serum

Credit goes to Karl Landsteiner who, first of all, in the year 1900, studied the nature of blood in a scientific way. The fact why the transfusion of blood from one person to another resulted in a severe shock or death of the recipient moved him very much and he began to search out the reason. After painstaking researches in this line he, at last, discovered the exact causes of the clumping together of the blood corpuscles. Landsteiner divided the human beings into three groups according to the nature of their blood groups which later on increased to four by Sturli and Decaste'lo. These groups have been represented as O, A, B, and AB. In the year 1911, further sub-divisions of A and B, had been put forward by Von Dungern and Hirschfeld.

If certain substances, mainly proteins, are introduced into an animal body, the tissues will react by producing a special reacting substance—the *antibody*. The foreign substance that

has been introduced is termed as *antigen*. If the antigen and the antibody come in close contact, they form a physio-chemical union. As for example, if the serum is taken from a person of A blood group and is injected into the body a person belonging to B blood group, the latter's blood cells will clump together. This phenomenon is known as *agglutination*. An *agglutinin* is a special antigen which is present on the surface of the red blood corpuscles. The *agglutinins* are antibodies found in the serum. When the *agglutinin* is united with the corresponding *agglutinin*, the blood cells coagulate. The occurrence of coagulation of the blood cells in the animal body causes a great shock and more often death as the coagulated blood cannot flow through the veins. There are two-kinds of antigens or *agglutinogens* and two corresponding antibodies or *agglutinins*. The two antigens have been designated as A and B and the antibodies as anti-A and anti-B. The blood cells containing antigen A when come in contact with the serum containing antibody anti-A will agglutinate. Similarly, the blood cells containing antigen B will agglutinate by the serum containing the antibody anti-B. This can be arranged in a tabular form for easy reference.

Table 12.

<i>Blood Group</i>	<i>Causes agglutination on groups</i>	<i>Does not cause agglutination on groups</i>
A	B, AB,	A, O
B	A, AB	B, O.
AB	—	A, B, AB, O
O	A, B, AB	O

The most simple method of testing a certain type of blood is given below. But this should be done with great caution. The sample of the blood should be collected, first of all, in two cleaned glass test tubes and then these should be treated with two known blood sera A and B. A little quantity of saline water is to be mixed up with the blood sample for avoiding clump. If the blood in the test tube agglutinates in A serum, then the

sample will belong to B group. On the other hand, if the sample agglutinates in B serum, it can be placed in A group. If agglutination takes place in both the A and B sera, the blood sample may be placed in AB group. The blood will be of O group if no agglutination occurs either in A or in B serum. The whole phenomenon can be summarized in the following table.

Table 13

<i>Unknown blood sample</i>	<i>Serum Anti-A (known)</i>	<i>Serum anti-B (known)</i>	<i>Groups found out</i>
1	No	No	O
2	Yes	No	A
3	No	Yes	B
4	Yes	Yes	AB

'Yes' indicates 'agglutination' and 'no' indicates 'no agglutination'.

The blood group test has a special importance in the field of medicine where blood transfusion must be conducted carefully. For transfusion the blood types of the donors and the recipient must be mutually compatible, otherwise the corpuscles of the recipient will be clumped together and ultimately give him a severe shock and even death. It is also used by the court as an evidence for detecting the criminals, doubtful parentage and interchange of children etc. In anthropology the blood group is used in studying the racial features, racial migration, population genetics and the like. The blood transfusion can be made safely only when the groups of the donors and the recipient are known beforehand. The persons belonging to O group can be able to donate blood to all the persons and due to this fact they are called as the *universal donors*. On the other hand, persons belonging to the group AB can receive blood from persons belonging to all the other groups and, this is why, the person with AB blood group is known as *universal recipient*. The following table will give an idea regarding the exact feature of the blood transfusion.

Table 14

<i>Persons belonging to blood groups.</i>	<i>Can donate blood to persons belonging to groups.</i>	<i>Can receive blood from persons belonging to groups.</i>
A	A, AB.	A, O.
B	B, AB.	B, O.
AB	AB	A, B, AB, O.
O	A, B, AB, O.	O.

### Genotypical and phenotypical features of Blood Groups

The three genes in the chromosome viz. A, B, and O are responsible for the blood groups of various persons. A and B type of genes possess equal expressive power while the gene O is recessive to both A and B. It is seen that due to the internal mixture of the following genes genotypically six different types of blood groups may be formed, but because of the recessiveness of O gene we get phenotypically four blood groups. This phenomenon can better be explained by the following table.

Table 15

<i>Sperm possess- ing gene.</i>	<i>Ovum possess- ing gene</i>	<i>Genotypic char- acter (of the blood group) of the offspring after fertili- zation.</i>	<i>Phenotypic cha- racter (of the blood group) of the offspring.</i>
A	A	AA	A
A	B	AB	AB
A	O	AO	A
B	A	BA	AB
B	B	BB	B
B	O	BO	B
O	A	OA	A
O	B	OB	B
O	O	OO	O

**Other Blood Types :**

Besides the above blood groups and their sub-divisions there are other blood types which act independently. They do not interfere in blood transfusion ; also they do not enter much into anthropological serology.

**M. N. Blood Type :**

Completely different types of genes are present in the blood which have been designated by the letters M and N. The two genes have constituted the three blood types viz. M, N and MN. The genotypic and phenotypic features of these genes may be tabulated as follow :—

**Table 16**

Sperm possessing gene	Ovum possessing gene	Genotypic character ( Blood group ) of the offspring after fertilization	Phenotypic character (Blood group) of the offspring
M	M	MM	M
M	N	MN	MN
N	M	NM	MN
N	N	NN	N

**Rh Blood Type :**

This new blood type, discovered by Landsteiner and Weiner in 1940, is of special interest in various ways. Both the scientists have jointly marked that a serum may be obtained by injecting the blood of a rhesus monkey into the body of a rabbit. This particular serum, it is seen, agglutinates certain human blood. This new blood type is known as Rh factor. The persons who possess this factor are known as Rh-positive and persons who lack it are known as Rh-negative. The

workings of this blood type are quite independent from those of all the other blood types. The greatest importance of Rh-factor lies in connection with pregnancy. If a Rh-negative woman possesses, in her womb, a Rh-positive baby, the agglutininogen can often pass through the placenta from the foetus which ultimately enter into the mother's circulation. Here it will produce an antibody and it then enter into the blood of the foetus by diffusion through the placenta. The blood of the foetus contains agglutininogen and, therefore, it will react with the antibody thus entered. This phenomenon will ultimately affect the baby in the womb who may die before birth. If it does not die it will receive a severe injury in some of its organs. More often a disease known as *Erythroblastosis foetalis* occurs to the new-born baby. Various types of works on Rh-factor and its sub-types are being conducted, now-a-days, in different parts of the world and, it is hoped that, in near future it would have been possible to throw more light on the genetics of this particular blood type.

### THE DISTRIBUTION OF BLOOD GROUPS

The distribution of blood groups and blood group genes amongst the peoples inhabiting in the different corners of the earth have already been known by various kinds of works conducted by the different scientists. According to one theory, O group is said to be the original type characteristic of primitive man. Among most of the American Indian tribes O group is very common. Group A dominates in Central and Western Europe, and group B is very frequent in Asia. On this ground it has been said that A and B occurred by mutation in these places. A group originated in the west and then it spreaded in all parts of the world. Similarly B type of blood, after its origin in Asian countries, might have been spreaded in different places through migration. Some reject the mutation theory on the ground that the anthropoid apes also possess A and B blood groups. But Synder has remarked that parallel independent mutations might have taken place in man and apes.



O and A groups are most commonly found among the primitive and peripheral people and, therefore, it is thought that, A might have been originated earlier than B. In Australia, O and A are common. Among the Australians, Hawaiians etc., B is almost absent. Also B group is not commonly found among the primitive tribes.

On the whole, it has been seen from the serological data that in Europe A exists in a very high frequency. B is very common amongst the Asiatic peoples. B or AB types are not common among the primitive and peripheral peoples. In India, O group is commonly met with the primitive tribes. The Konyak and the Angami Nagas show the highest frequency of O group. The higher caste people show more tendency towards O group in comparison to the people of the lower castes. The Black Jews of the Deccan show a very high percentage of O group (73.50). However, Indian serological data advocate the highest frequency of B group amongst the people. Due to the preponderance of B in India and its lower incidence amongst the peoples of Tibet, Burma etc. some authors believe that India might have played an important role in the dispersion of B type of blood. Macfarlane has investigated the distribution of B group in India. According to her, B group has been dominating in India for millennia. It might have been originated in the ancestors of the lower caste people inhabiting in the north-east region, and from where it has entered into the higher caste people. Majumdar has said that the concentration of B is commonly found amongst the social groups that have passed from tribal to caste groups. In Bengal, the castes which have occupied the lowest social status show highest frequency of B. On the other hand, the tribes like Naga, Bhil, Paniyans etc. do not exhibit the frequency of B. The tendency of B increases amongst those tribal groups who mix with all the neighbouring caste and tribal groups and allow inter-tribal or extra-marital unions. But this fact needs more researches and explanation. Recent study regarding the blood group on castes and community

basis in India advocates that A is very common among the higher caste people in comparison to the people of the lower castes who, in turn, show high frequency of B which, however, is uncommon in the tribal population. Some authors are of opinion that hybridization is a most important factor in the concentration of B in India.

### RACIAL CLASSIFICATIONS BASED ON BLOOD GROUPS

Attempts have been made, first of all, regarding the scientific study of the blood groups by the two Polish doctors, Drs. Hirzfield, when they examined troops in the Macedonian Army in Serbia during the 1st World War. At the time of their examinations they found that the percentage of four blood groups varied in different races. This information gave the anthropologists and other scientists related to the human physiology a clue and they began to study the races of man by the characters hidden in their blood. But the results of their study in that new technique did not, naturally, coincide with the works done earlier e. g. the racial classification based on morphological characters. Therefore, it had to face severe criticisms and the whole technique had been viewed then with great suspicion. But during the recent period different serious types of works in this particular line have opened the eyes of all the scientific personnel who jointly believe that the blood group is the most reliable and authentic basis for framing a racial classification. There are a lot of advantages in this particular field which have been summarized below.

- 1) The first advantage of harnessing the blood groups as a basis for racial classification is that they inherit in a Mendelian fashion.

- 2) They do not change by influence of climate, food, illness etc. and, therefore, in this case, there is no chance of error which generally occurred in the case of morphological features.

3) The frequency of the blood group in any population forms a stable characteristic.

4) The blood groups most probably arose very early in man's evolution.

5) The blood groups are sharply distinguishable characters.

The human race which is very ancient type has been witnessing various influences and has dispersed to the various parts of the world from some areas of origin. In this long process of migration mixing and re-mixing among the various races of man have taken place which have resulted in the formation of the present day blood groups.

The racial classification on the basis of A B O blood groups had been taken up, first of all, by Ottenberg (1925) in the following way—

- 1) European
- 2) Intermediate—Russians, Turks, Arabs, etc.
- 3) Hunan—Japan, South China, Hungary, etc.
- 4) Hindu—Manchu, Korea, North China, Gypsies, Hindu.
- 5) Afro-Southern Asiatic—Negroes, Madagascars, Malays.
- 6) Pacific-Amerindians—Indians, Australians, Philipinos, Icelanders.

This classification exhibits some basic errors especially in placing the Australians with the Icelanders. But it should be remembered that Ottenberg was the pioneer in this line and he had to face many difficulties due to the want of sufficient data regarding blood groups. However, his new technique has given initiative to the latter workers in this particular line.

Then Labovary, in the year 1946, had tried to attempt at the racial classification by using the serological characters. His results can be summarized in the following lines.

- 1) European—Nordics and Alpines of Europe, and the Near East.
- 2) Mediterranean

- 3) Mongolian—Central Asia and Euresia.
- 4) African—Blacks
- 5) Indonesians
- 6) American Indians
- 7) Ocenic, including the Japanese.
- 8) Australian.

Lahovary based his classification on the M and N genes besides the normal A B O groups.

By using the A B O groups and Rh factors of the blood Weiner has divided the races of the world into three groups.

- 1) Caucasoid
- 2) Mongoloid
- 3) Negroid.

The most recent classification of the races of mankind on the gene frequency method is that of Boyd (1950). He has attempted to classify the races by studying the A B O ; MN and Rh factors of the blood. His classification is like the following.

- 1) Early European group ( hypothetical )
- 2) European group ( Caucasoid )
- 3) African group ( Negroid )
- 4) Asiatic group ( Mongoloid )
- 5) American Indian group
- 6) Australoid group.

It is not possible to say one classification is more correct than the other. Its importance should be determined by the purpose for which it is to be used. It is not wise to depend on one set of characters for racial discrimination. In order to classify a group of people it is better to employ all types of characteristics as practicable, and these must be varified in relation to the geographical distribution. It is seen that various workers in this field have tried to correlate the blood groups with the different morphological characters viz. stature, weight

of the body, skin colour, hair-form etc. But, in fact, it is very difficult to establish this sort of relationship. Still the application of blood group test has produced the important and satisfactory results in studying racial relationship and tracing racial migrations. The blood group is strictly a genotypic feature, unlike all other criteria for racial classification, which works in a scientific way and, therefore, it is more helpful in the scientific study. It is hoped that more researches in this field will someday unfold various new facts that are still unknown to the present workers.

VARIETIES OF THE MODERN  
RACES OF MAN

*There are different kinds of people who inhabit in the different parts of the world. Attempts have been made by the ethnologists to compare and study the human differences and also they have tried to group the people into different categories. Their classifications are based on the relative commonness of certain traits. What are those traits and how they have been employed to study the varieties of the modern races of man?*

## THE THREE MAJOR RACES

[It is troublesome to divide the population of the world into clean-cut races as the dividing lines between the races are arbitrary. The mixture and wanderings of the races of man have been taking place from the period of man's differentiation. During the Neolithic period the intermingling and redistribution of the races reached at the maximum point. However, on the basis of relative commonness of traits, the scientists have attempted to divide the mankind into three major racial types which, in turn, are again divided into a greater number of sub-races. The three major races are *Caucasoid*, *Mongoloid*, and *Negroid*. It has been stated that half of the people of the world are Mongoloid in feature, one-third are Caucasoid and one-tenth mainly show Negroid characteristics. The rest of the people show such characteristics that they cannot be

# CHARACTERISTIC FEATURES OF THE THREE MAJOR RACES OF MANKIND

CHARACTERS	CAUCASOID	MONGOLOID	NEGROID
1. <i>Head form</i>	Long to broad <sub>1</sub>	Broad <sub>2</sub>	Long <sub>3</sub>
2. <i>Head height</i>	Medium to very high	Medium	Low to medium
3. <i>Face form</i>	Narrow to medium broad	Medium to very broad <sub>4</sub>	Medium broad to narrow <sub>5</sub>
4. <i>Pognathism</i>	Absent	Rare <sub>6</sub>	Marked
5. <i>Nose form</i>	Long and narrow	Medium	Broad
<i>bridge</i>	High	Low	Low
<i>profile</i>	Straight, concave or convex	Usually concave	Straight or concave
6. <i>Eye form</i>	Occasional presence of lateral fold.	Medial epicanthic fold common	Vertical fold common
<i>colour</i>	Light blue to dark brown	Brown to brown-black	Dark brown to black
7. <i>Hair form (head)</i>	Straight to wavy	Straight	Woolly
<i>Colour</i>	Light brown to dark brown	Dark brown	Dark brown to black
<i>texture</i>	Fin to medium	Coarse	Coarse
<i>cross section</i>	Usually ovaloid	Round	Flat oval

8. <i>Body hair</i>	Moderate to heavy	Sparse	Slight
9. <i>Beard and moustache</i>	Moderate to heavy	Slight to moderate	Absent to slight
10. <i>Lips</i>	Thin to medium	Medium <sub>7</sub>	Very thick <sub>8</sub>
11. <i>Skin colour</i>	Reddish white to light brown <sub>9</sub>	Light yellow to yellowish brown <sub>10</sub>	Brown to sooty black
12. <i>Stature</i>	Medium to tall	Medium short to medium tall	Very short to tall.

1. Longheadedness is very common among the Caucasoid group but cases of brachycephaly and mesocephaly also occur in considerable number.

2. A few Mongoloid people show dolichocephalic characteristics e.g. the American Indian groups.

3. Among the Negroids the dolichocephaly is common but sometimes broad head may also occur.

4. In the case of the Mongoloid people the cheek bones tend to be high and flat.

5. The Negroids possess narrow and long face but it is less narrower and longer than that of the Caucasoid.

6. Among the Mongoloids the prognathism is not generally found. But, when present, it is medium to slight.

7. Sometimes heavy integumental lip are found among the Mongoloids.

8. Among the Negroes the lip is too everted, and this feature is not present among the Caucasoid and the Mongoloid people.

9. The skin colour of the Caucasoid shows a wide range of variation. A few show white skin, the other may be swarthy white or light to olive brown in colour

10. Reddish brown skin may also be met among the Mongoloids.



placed readily into any one of these major racial groups. The Caucasoid characteristics are mainly found among the Europeans and their descendants. The Mongloid people are found chiefly in Asia and Indonesia. The Indians of North and South America exhibit Mongoloid features. The Negroid features are to be met with among the population of Africa, Melanesia. The descendants of the African people in the United States, who came here as slaves, show Negroid characteristics.

Now let us try to examine the chief characteristic features of the three major races of the world and see the points of differences. In this discussion, only the chief features have been taken into consideration.

### The Sub-races of man

The major races, just described, are composed of people showing wide variations of physical features around certain special characteristics. Various efforts have been made by different authorities to classify these groups which are known as sub-races. In the following pages an attempt has been made to give a general outline of various racial groups that are found within the present day people of the world. It should be mentioned here that due to the increase of intermixture in modern times some of these ethnic groups are gradually losing their distinctive features.

### ✓ CAUCASOID

This racial type embraces numerous groups with variety of racial elements. The generalised characters of this racial type are the following—

Skin colour—White, light brown, pink, olive

Hair form—It ranges from flat wavy to different degrees of curliness

Hair colour—Lighter shades ; rarely dead black

Hair texture—Medium to fine, rarely coarse

Body and face hair—Moderate or abundant

Eye colour—It is of lighter shades  
 Head form—Ranges from dolichocephalic to  
                   brachycephalic.  
 Nose form—Leptorrhine to mesorrhine;  
                   platyrrhine never occurs  
 Nasal bridge—High  
 Facial prognathism—Usually absent  
 Chin—Pronounced or medium  
 Forehead—Usually high  
 Lips—Medium to thin  
 Stature—Tall



The Caucasoid

## 1. MEDITERRANEAN

### *Distribution*

The people belonging to this group are found chiefly on most of the Mediterranean basin. They are also seen spread as far as British Isles in the north, Sahara in the south, and India, Arabia, Afghanistan and Pakistan in the eastward direction.

The Mediterranean sub-race has been divided into three distinct groups each of which has been described below.

### A. Classic Mediterranean

#### *Distribution*

This type is distributed in Portugal, France, Spain, Germany, Italy. It is also seen in most parts of Europe. The Egyptians and the Berbers of Morocco also represent this type.

#### *Physical features*

Skin colour—Light brown to burnet.  
 Hair form—Deeply waved, sometimes curly  
 Hair colour—Black  
 Eye colour—Usually dark  
 Head form—Dolichocephalic to mesocephalic  
 Nasal index—Usually leptorrhine  
 Forehead—Mediumly high with moderate slope

Face—Long and oval  
Cheekbones—Flat  
Chin—Pointed  
Stature—Medium

#### B. Atlanto-Mediterranean

##### *Distribution*

The people belonging to this type are found in Palestine, Iraq, North Africa, Eastern Balkans etc. They are also present in Ireland, Spain and Portugal.

##### *Physical features*

Skin colour—Darker  
Hair form—Wavy to curly  
Hair colour—Black  
Eye colour—Medium brown to dark brown  
Head form—Dolichocephalic to mesocephalic  
Nose form—Straight with medium height and breadth  
Fore head—Usually receding  
Brow-ridges—Well developed  
Face form—Long with deep jaws  
Cheekbones—Prominent  
Stature—Usually tall but medium stature also occurs  
(Average 170 cm)

#### C. Indo-Afghans

##### *Distribution*

The people of this type are mostly found in Afghanistan, Iraq, Iran, Beluchistan, N. W. India and Pakistan.

##### *Physical features*

Skin colour—Light brown  
Hair form—Wavy  
Hair colour—Black  
Body and face hair—Usually heavy  
Eye colour—Dark

Head form—Dolichocephalic to mesocephalic  
Nose form—Leptorrhine  
Nasal bridge—Straight or convex  
Face form—Long and narrow  
Stature—Usually medium (Average 167 cm)

*Remarks*

The Mediterranean is regarded as the oldest white sub-race. It embraces a great group of mankind. It is not easy to say with certainty the exact time of its origin but certain prehistoric human forms such as Galley Hill, Swanscombe etc. exhibit certain features of Mediterranean type. The Mediterranean people spread over in large numbers in Europe, North Africa, Near East, Ethiopia, the region of the Upper Nile, South Eastern Asia as early as the commencement of the Neolithic period. During the said period they had shown much skill in domesticating plants and animals, in weaving and pot making, in erecting stone monuments and in other such factors.

## 2. AINU

*Distribution*

Northern Japan, South Sakhalin and Yezo.

*Physical features*

Skin colour—Light brown  
Hair form—Wavy  
Hair colour—Dark brown to black  
Body and face hair—Abundant  
Eye colour—Light brown  
Head form—Dolichocephalic to mesocephalic  
Nasal root—Depressed  
Nasal bridge—Moderately high  
Facial profile—Concave  
Nasal index—Mesorrhine  
Forehead—Not slanting.  
Brow-ridges—Large

Face form—Mesoprosopic  
 Facial prognathism—Moderate  
 Lips—Medium to thin  
 Stature—158 cm. in average

*Remarks*

This group represents a very ancient racial stock of Japan. They show a close resemblance to the Australoids and due to which some ethnologists want to put them in the said group. Prof. Hooton opines that a recent Mongoloid admixture may be noticed in most of the Ainus.

### 3. NORDIC

*Distribution*

The people belonging to this type are distributed in Scandinavia, Baltic region, Northern France, Northern Germany, British Isles, Netherlands and Belgium. They are also seen in United States and British colonies.

*Physical features*

Skin colour—Usually pink or reddish white  
 Hair form—Straight or wavy  
 Hair colour—Blond, yellow or light brown  
 Body and face hair—Moderate  
 Eye colour—Blue or grey  
 Head form—Mesocephalic  
 Nasal root—High  
 Nasal bridge—High or narrow  
 Nasal profile—Straight  
 Nasal index—Leptorrhine  
 Forehead—Slightly sloped or vertical  
 Brow-ridges—Small  
 Face form—Longish ; narrow, straight in profile  
 Cheek bones—Flat  
 Lips—Thin to very thin  
 Chin—Prominent  
 Stature—Tall ; ( Average height 172 cm. )

*Remarks*

Various conclusions have been drawn by the different anthropologists regarding the origin and history of Nordic racial type. Some authorities had mentioned that the Nordic population possessed beautiful structural traits, good mental capacity, greater spiritual capacities and the maker of well-developed civilization. But, in reality, these facts are baseless. Some went so far as to say that the Nordic people were the 'Aryans' and they had done much in the development of the Aryan language. But most of the modern anthropologists strongly protest this view. Prof Hooton opines, 'I know of no sound body of evidence—archeological, historical, linguistic, craniological, or anthropometric—that supports the hypothesis that Nordics have any more to do with the origin and prehistoric diffusion of Aryan language than have Alpines, or Dinaric, or even the sub-race that I have called Keltic.'

#### 4. ALPINE

*Distribution*

The people of this type are found in Central and Eastern Europe. They are also found in Southern Norway, Denmark, Balkans, North Italy, and Asia minor.

*Physical features*

Skin colour—Burnet white

Hair form—Slightly wavy to straight

Hair colour—Medium brown or dark brown

Body and face hair—Abundant

Eye colour—Dark brown or medium brown

Head form—Brachycephalic

Nasal root—Medium high

Nasal bridge—Medium height and width

Nasal profile—Straight

Nasal index—Leptorrhine; often mesorrhine

Forehead—High

Brow-ridges—Moderately or strongly developed

Face form—Relatively broad and short

Lips—Moderately thick

Chin—Prominent

Stature—Medium to short (Average-166 cm).

#### *Remarks*

The Alpines exhibit some Ainu affinities, but differ in round headedness, lesser hairiness and in greater refinement of the face, etc. Some authorities relate the Alpine race with the Asiatic Mongoloid and say that the former has originated in central Asia. The admixture of the Alpine racial type with other types such as the Nordic, Mediterranean etc is also seen. It is said that the Beaker-Folk have been originated due to a cross between the Nordic and the Alpine racial groups.

### 5. ARMENOID

#### *Distribution*

These people are concentrated in Palestine, Syria, Turkey. The Armenoid people are also found in Greece, Bulgaria, and United States.

#### *Physical features*

Skin colour—Tawny white or olive

Hair form—Wavy to curly

Hair colour—Brown to black

Body and face hair—Abundant

Eye colour—Dark brown to medium brown

Head form—Brachycephalic

Nasal root—Very high

Nasal bridge—Very high, narrow

Nasal profile—Usually convex

Nasal index—Leptorrhine

Forehead—Sloping

Brow-ridges—None

Face form—Narrow and elongated

Lips—Moderately thick and full

Chin—Medium prominence

Stature—Medium to tall ( Average 167 cm. )

*Remarks*

The Armenoids exhibit classic Mediterranean, Alpine, Nordic racial features in them. It has been said that this particular group is resulted from a stabilized interbreed between Mediterraneans and Alpines. After a careful study with a good number of Armenoid skulls Dr. Byron has come to the conclusion that Alpine, classic Mediterranean and a minor amount of Nordicelement have entered into the formation of this race. Asia Minor may be called as the earliest known center of development for Armenoid race. From this site the Armenoid people might have been spread southward to Arabia and India. The statue of a bearded man that has been discovered from the ruins of Mohenjodaro shows Armenoid nose and a pointed head. The Armenoid elements of similar type have also been found among the Babylonians, Assyrians, and Hittites.

## 6. DINARIC

*Distribution*

The people of this group are chiefly found in Dinaric Alps region in Yugoslavia, Austrian Tyrol. They are also found sporadically in Central Europe.

*Physical features*

Skin colour—Olive to brunet

Hair form—Straight or wavy to curly

Hair colour—Brown to black

Body and face hair—Abundant

Eye colour—Brown or black

Head form—Brachycephalic

Nasal root—High

Nasal bridge—High, narrow



Nasal profile—Straight or convex

Nasal index—Leptorrhine

Fore head—Straight or sloping

Brow-ridges—None

Face form—Long and narrow

Lips—Moderately full

Chin—More or less projecting

Stature—Tall (Average 172 cm)

*Remarks*

It is said that the Dinaric race exhibits both Nordic and Armenoid characteristics and, therefore, the former one is regarded as more recent in comparison to the latter two groups.

## 7. EAST BALTIC

*Distribution*

These people are seen in Finland, North Eastern Germany, Poland, Baltic States and Russia.

*Physical features*

Skin colour—Tawny white

Hair form—Straight

Body and face hair—Usually scanty

Eye colour—Gray or blue

Head form—Brachycephalic

Nasal root—Medium to low

Nasal bridge—Medium high and broad

Nasal index—Mesorrhine

Forehead—Vertical

Brow-ridges—Moderate

Face form—Square

Lips—Medium, thin

Chin—Well developed

Stature—Extremely variable; short and medium predominates

*Remarks*

The East Baltic race exhibits certain physical traits which suggest the mixture of various sources. In these people Nordic and Alpine influences are dominant. Certain characteristics on the face, nose and eyes of these people suggest Asiatic Mongoloid features. The Alpine influence may be observed on form of the head, forehead, body built and stature of the people. The racial history of this type is practically unknown.

## 8. POLYNESIAN

*Distribution*

They live in Friendly islands, Samoa, Hawaii and Marquesas etc.

*Physical features*

Skin colour—Light brown to yellow brown

Hair form—Wavy, sometimes straight, rarely curly

Hair colour—Dark brown to black

Body and face hair—Sparse

Eye colour—Dark brown

Head form—Usually brachycephals, but meso and dolichocephals present

Nasal root—High

Nasal bridge—High, broad

Nasal index—Usually mesorrhine

Forehead—Slightly sloping

Brow-ridges—Little or none

Face form—Mesoprosopic to Leptoprosopic

Lips—Moderately thick

Chin—Well developed

Stature—Tall (Average 178 cm)

*Remarks*

It is a composite race. These people are said to have originated due to the intermixture amongst the peoples of early Mediterranean, Asiatic Mongoloid, and Oceanic Negro types.

## 9. KELTIC

*Distribution*

These people are found in Ireland, Scotland and Wales. They are also found in small numbers in England and other parts of the world.

*Physical features*

Skin colour—Pale white

Hair form—Usually wavy or curly

Hair colour—Medium to dark brown

Eye colour—Blue or gray

Head form—Mesocephalic

Nasal bridge—Medium high

Nasal index—Leptorrhine

Face form—Long and narrow

Chin—Deep

Stature—Tall (average-172 cm)

*Remarks*

The term Keltic, according to Hooton, has been wrongly used. Though it is mainly found in the Keltic areas yet there are evidences regarding the fact that in Ireland Keltic subrace is not the original carrier of Keltic language. The Keltic characteristics are now-a-days less found among the Keltic speakers than those are found among other types of Ireland.

## ARCHAIC CAUCASOID RACES

The following are the characteristic types of the archaic Caucasoid races. These types possess some primitive features which indicate that they are fragmentary survivals of some early Caucasoid varieties. Let us discuss the main physical features of these types.

## 1. AUSTRALOID

*Distribution*

They are concentrated in Australia.

*Physical features*

- Skin colour—Dark brown  
Hair form—Wavy or curly  
Hair colour—Medium brown to black  
Body and face hair—Abundant  
Eye colour—Dark brown  
Head form—Dolichocephalic  
Nasal root—Markedly depressed  
Nasal bridge—Low, broad  
Nasal index—Platyrrhine  
Forehead—Receding  
Brow-ridges—Very large  
Face form—Short ; prognathism present  
Lips—Medium  
Chin—Usually receding  
Stature—Variable (Average 165 cm).

## 2. DRAVIDIAN

*Distribution*

These people are mainly found in South and Central India

*Physical features*

- Skin colour—Dark brown  
Hair form—Wavy or curly  
Hair colour—Black  
Body and face hair—Scanty  
Eye colour—Dark brown  
Head form—Dolichocephalic  
Nasal root—Depressed  
Nasal bridge—Moderately high  
Nasal index—Usually mesorrhine  
Forehead—Slightly sloping  
Brow ridges—Slight or none  
Face form—Narrow ; little or no prognathism  
Lips—Medium to thick  
Stature—Medium (Average 164 cm).

## 3. VEDDA

*Distribution*

They are found in Ceylon.

*Physical features*

Skin colour—Dark brown

Hair from—Wavy or curly

Hair colour—Black

Body and face hair—Very little

Eye colour—Dark brown

Head form—Dolichocephalic

Nasal root—Depressed

Nasal bridge—Low, broad

Nasal index—Platyrrhine

Forehead—Slightly sloping

Brow ridges—Moderate to large

Face form—Short and broad

Lips—Medium

Chin—Usually receding

Stature—Short (Average 152 cm).

*Remarks*

In the above three racial types Negroid features are usually seen. As for example, the platyrrhine nasal index of the Australoids and the Veddas, low and broad nasal roots of all of them, marked prognathism of the Australoid, and dark brown to black skin colour suggest the characteristic features of the black races. Some are of opinion that this has resulted due to an admixture with a Negrito stock in the earlier periods.

## MONGOLOID

The history of the Mongoloid people has not yet been known clearly. But from the distribution of unmixed types of elements some suggestions have been made. It has been said

that this racial type has originated somewhere in the vast steppe lands of Central Asia and from where they have spread at the different directions. The following are the characteristic features of this racial type :—

Skin colour—Yellow or yellow brown

Hair form—Straight

Hair colour—Black

Hair texture—Coarse

Body and face hair—Scanty

Head form—Usually brachycephalic

Nasal root—Very low

Nasal bridge—Low and medium breadth

Nasal profile—Usually concave or straight

Eye form—Oblique with narrow slit-like opening ; total epicanthic fold in the upper lid

Eye colour—Medium to dark brown

Face form—Flat

Stature—Variable



The Mongoloid

### **SUB-RACES**

The Mongolian race is sub-divided into the following types—

#### **1. CLASSIC MONGOL**

##### *Distribution*

This type is distributed in Northern China, Siberia, Central Asia.

##### *Physical features*

Skin colour—Yellow or Yellowish brown

Hair form—Straight

Hair colour—Black

Body and face hair—Sparse

Eye colour—Medium to dark brown

Eye form—Slit-like opening ; total epicanthic fold

Head form—Usually brachycephalic

Nasal root—Not depressed

Nasal bridge—Low and medium

Forehead—Rounded and medium high  
Face form—Very broad; square jaws  
Stature—Variable

*Remarks*

This type is represented by the people likes Goldi, Gilyak, Buriat, Konyak, Tibetans, etc.

## 2. ARCTIC MONGOL

*Distribution*

They are found in Northeastern Asia and Arctic fringe of North America.

*Physical features*

Skin colour—Darkish yellow to brownish  
Hair form—Straight  
Hair colour—Black  
Body and face hair—Scanty  
Eye colour—Black  
Eye form—Mongolian fold less frequent  
Head form—Variable  
Nose form—Narrow  
Face form—Very broad, very long  
Stature—Usually small (Average 160 Cm).

*Remarks*

The representatives of this racial type are the Eskimos, Chukchis, Kamtchadales, etc.

## 3. INDONESIAN MONGOL

*Distribution*

They are distributed in Japan, Thailand, Burma, Malay Peninsula, Philippines, Dutch East Indies, Indo-China etc.

*Physical features*

Skin colour—Dark yellow brown to red brown  
Hair form—Usually straight  
Hair colour—Black, with occasional reddish tinge  
Body and face hair—Scanty

Eye colour—Medium to dark brown

Eye form—Occasional Mongolian fold

Head form—Mesocephalic to Brachycephalic

Nasal root—Slightly depressed

Nasal bridge—Low

Nasal index—Mesorrhine

Face form—Short, broad and prominent cheek bones

Lips—Thicker than in former type

Chin—Short

Stature—Averaging from 155 Cm. to 163 cm

There are two secondary sub-races of this type which have been described below with their characteristic features:—

#### (a) MALAY-MONGOL

Characteristic features :

Hair form—Straight

Head form—Cephalic index ranges from 85 to 86

Skin colour—Light yellow brown to black yellow brown

#### (b) INDONESIAN

Characteristic features :

Hair form—Usually wavy

Head form—Cephalic index under 80

Skin colour—Light red brown to medium brown

#### *Remarks*

In Malay type the Mongolian influence is more prominent than in the Indonesian type. The latter type differs from the former in its short stature, tendency to dolichocephaly or mesocephaly, wavy hair, longer and narrower nose, more oval face and straight eyes. But the Malay type is distinctly brachycephalic with frequent Mongoloid eye, straight hair, more prominent cheek bones etc.

### 4. AMERICAN MONGOL

#### *Distribution*

These people are distributed in the different areas of Middle, North and South America.



*Physical features*

Skin colour—Yellow brown to red brown

Hair form—Straight, rarely wavy

Hair colour—Black, rarely dark brown

Body and face hair—Sparse

Eye colour—Dark brown to black

Eye form—Complete Mongolian fold absent, external fold found

Head form—Dolicho-mesocephalic and Brachycephalic

Nose form—Long

Nasal bridge—High and convex

Nasal index—Predominantly mesorrhine

Forehead—Sloping

Brow-ridges—Strongly developed

Face form—Broad

Lips—Thin

Chin—More prominent than in other Mongoloid

Stature—Variable

*Remarks*

A large number of varieties and sub-types are found today among the Amerindians. These diverse types have been said to have developed due to following facts. These have developed as a result of mixtures with non-Mongoloid types. Also these may be described as local strains developed through mutation and isolation. More works on physical affinities of the American Indians are still to be done in order to get a clear idea regarding racial characteristics of them.

## NEGROID

As regards Negroid racial types very scanty data are available. This is why it has not been possible to classify this type in a more detailed and systematic way. The following are the characteristic features of the Negroid racial type.

Skin colour—Dark brown to black

Hair form—Woolly or frizzly

Hair colour—Black

Body and face hair—Little body hair and sparse face hair

Eye colour—Dark brown to black

Head form—Predominantly dolichocephalic

Nasal bridge—Low and broad

Nose form—Broad and flat

Forehead—Rounded

Brow-ridges—Small

Lips—Thick and everted

Chin—Rounded and receding

Ear form—Usually short, wide, with rolled helix and little or no lobe



The Negroid

### SUB-RACES

#### 1. PIGMY NEGRITOS

##### *Distribution*

They are found in Congo forest of Africa, Malay Peninsula, Andaman Islands, and also in New Guinea and Philippines.

##### *General characteristics*

Skin colour—Dirty yellowish, medium brown

Hair form—Woolly or peppercorn

Hair colour—Black

Eye colour—Dark brown

Stature—Extremely small (less than 150 cm).

This racial group has been divided into two distinct types like the following—

##### (a) *Adult type*

Skin colour—Usually grayish yellow to light brown

Head form—Mesocephalic (Index under 80)

Nasal root—Narrow

Nasal bridge—Low

Nasal index—Usually over 100

Face form—Long and narrow

Forehead—Bulbous

Brow-ridges—Moderate

Lips—Upper lip long and convex.

Chin—Long but retreating.

(b) *Infantile type*

Skin colour—Usually darker than in adult type

Head form—Sub-brachycephalic (Index 80 or over)

Nasal root—Narrow

Nasal bridge—Low

Forehead—Prominent

Brow-ridge—Little or none

Face form—Short, broad

Lips—Moderate

*Remarks*

The Negrito people live in scattered bands in the deepest corners of the Congo forest. Numerically they are smaller than other types. It has been said that these particular types of people have been living here from a very long time. In latter years they have been driven out by the more advanced groups and they are forced to go to the inaccessible corners of the forest. According to Prof. Hooton the adult type of Negrito is oldest. He remarks, 'the relationship of the two types is obscure, but it seems probable that the infantile or foetalized type represents the later development, perhaps as a result of mutations suppressing the grosser and more specialized features of the adultiform type.'

## 2. FOREST NEGROES

*Distribution*

These people live in Western Africa, from the Sahara to the Southern edge of the tropical forest of equatorial Africa.

*Physical features*

Skin colour—Dark brown to black

Hair colour—Black

Body and face hair—Scanty

Eye colour—Dark brown to black

Head form—Dolichocephalic

Nasal root—Low

Nasal bridge—Low, broad  
Nasal index—Platyrrhine  
Forehead—Slightly sloped  
Brow-ridge—Little or none  
Face form—Usually short  
Lips—Thick, everted  
Stature—Medium ( 156 to 167 cm ).

*Remarks*

The Forest Negroes have been living in the region extending from the Senegal River in the West to Sudan, Uganda and Northern Rhodesia from time immemorial. It is thought that this race has been originated in West Africa because of the fact that Forest Negro traits are seen in no other human group of the world.

### 3. NILOTIC NEGROES

*Distribution*

They are found in the regions of Upper Nile Valley and Eastern Sudan.

*Physical features*

Skin colour—Black to bluish black  
Hair form—Woolly  
Hair colour—Dark brown  
Body and face hair—Scanty  
Eye colour—Dark brown  
Head form—Dolichocephalic  
Nasal root—Low  
Nasal bridge—Low, broad  
Nasal index—Platyrrhine  
Forehead—Sloping  
Brow-ridges—Little developed  
Face form—Broad and short  
Lips—Thick, everted  
Chin—Better developed than in Forest Negroes  
Stature—Average about 178 cm.

*Remarks*

The Nilotic Negroes possess certain physical features which are almost different from the true Negroes. It is said that at a certain period some infusion of Mediterranean blood has caused this. It is a known fact that some prehistoric Mediterranean people moved into Nilotic regions where they were absorbed by the Negroid people. The Nilotic Negroes of Northeastern Africa show marked Mediterranean features.

**4. OCEANIC NEGROES***Distribution*

These people are seen to have concentrated in New Guinea and neighbouring islands.

*Physical features*

Skin colour—Medium to dark brown

Hair form—Usually frizzly, rarely curly

Hair colour—Black

Body and face hair—Scanty

Eye colour—Dark brown, black

Head form—Usually dolichocephalic, sometimes brachycephalic

Nasal root—Depressed

Nasal bridge—High, broad

Nasal index—Platyrrhine

Forehead—Rounded or sloping

Brow-ridges—Small to prominent

Face form—Less prognathus

Lips—Medium to thick

Stature—Usually low (Average less than 165 cm.)

It has two distinct sub-types like the following :—

*(a) PAPUAN**Physical features*

Skin colour—Medium to dark brown

Hair form—Frizzly with lesser degrees of curve

Hair colour—Dark brown or reddish brown

Body and face hair—Abundant

Head form—Dolichocephalic

**Nose form.**—Broad, root is depressed, and convex profile

Forehead—Rounded and sloping

Brow-ridges.—Often heavy and continuous

Face form.—Prognathus

**Lips—Thin**

Stature\_\_Variable

(b) *MELANESIAN*

### Physical features

Skin colour.—Dark chocolate, copper coloured, very dark

Hair colour.—Dark brown

Body and face hair—Scanty

Nose form—Broad, root is deeply depressed, low-bridged, concave profile

Forehead—Wide and lower

Brow-ridges—Less developed

**Lips—Thick**

Stature—Variable

## Remarks

The Oceanic Negro race presents many primitive features than the other types e. g. the Nilotic Negro or the Forest Negro. The two sub-types, just described, differ from one another in certain minor details. One of them is found among the speakers of Papuan language living in the interior of New Guinea. The other is met with among the Melanesian people on the coast of New Guinea and the neighbouring places.

## 5. RUSHMAN-HOTTENTOT

**Distribution.**

They are found distributed in and around the Kalahari desert of Southwestern Africa.

### Physical features

Skin colour—Yellow to Yellow brown

Hair form—Peppercorn

Hair colour—Black

Body and face hair—Scanty

- Eye colour—Dark brown  
Eye fold—Inner fold frequent  
Head form—Dolichocephalic to mesocephalic  
Nasal root—Very low  
Nasal bridge—Very Platyrrhine  
Forehead—Bulbous  
Brow-ridges—Slightly developed  
Face form—Shorter, squarer in the Bushman; more elongated in the Hottentot; Triangular.  
Lips—Usually thick  
Chin—Small  
Buttocks—Marked steatopygia in females. More pronounced in the Hottentot.

*Remarks*

The Bushman and the Hottentot show almost the same features as regards their physical characteristics are concerned. At one time they have occupied the greater portion of South Africa. They are regarded as the descendants of Fish Hoek, Olduvai, and Boskopman of the Pleistocene times. The Bushman were compelled to quit their original homeland due to invasion of Africa by the Nilotic Negroes. Also there developed a new racial type—the Hottentot—due to intermixture between the Bushmen and the Nilotic racial types.

The Bushmen and the Hottentots have more Mongoloid than Negroid characteristics. As for example, the inner eye fold and yellowish skin are easily distinguishable Mongoloid features.

### THE AMERICAN NEGROES

The American Negroes have attracted the attention of many scholars, social reformers etc. because of the several facts. Firstly, the Negroes are the most distinctive ethnic group; secondly, as a race they are the highest 'social visibility' of any of the racial groups; thirdly, their present condition is the result of long history of slavery; fourthly, the 'Negro problem' has created much sensation in the socio-cultural life of America.

The institution of slavery continued to grow rapidly in the United States throughout the first half of the 19th Century. In the United States, interbreeding between the different ethnic groups such as the African Negroes, American Indians and the Caucasoid began and it continued for long time. This long process of intermixture has resulted in two distinctive racial types—the North American Caucasoid and the American Negroes. The former group combines traits from most European Caucasoid races with some from the American Indian and the Negro while the latter type is more complex and is composed of Forest Negro traits, Caucasoid and a few American Indian features.

The following are the characteristic features of the Negroes of America.

**Head form**—It is dolichocephalic. Brow-ridges are small, but with a greater Caucasoid mixture they tend to increase.

**Nose form**—The nose exhibits intermediate characters between those of the Forest Negro and the Caucasoid. In comparison to the nose of the Forest Negro it is higher and narrower at the root and bridge.

**Face form**—It is somewhat longer than that of the Forest Negro. The American Negroes show little or no prognathism.

**Hair form**—It becomes longer and less woolly with the increase of Caucasoid and American Indian mixtures. The colour of the hair is usually black or dark brown.

**Eye colour**—It is usually dark brown or light brown.

**Skin colour**—It varies from olive to dark brown; with the increase of Caucasoid mixture the skin colour tends to be lighter.

**Stature**—On the average, they are taller in comparison to the Negroes of West Africa.



## RACE ELEMENTS IN INDIAN POPULATION

*India has been called as the melting pot of races. At different times the people with various ethnic elements came on this sub-continent, and they had mixed, blended and segregated which resulted in a complex race element in Indian population. At all the times the Raciologists have to face much difficulties in tracing out the ethnic history of India. What India speaks regarding her race elements that have been studied and classified by the ethnologists ?*

[It is very difficult to present a clear picture about the racial elements of the people of India as the evidences regarding these are very scanty. The various ethnic groups who inhabited in the different parts of India are still not known correctly due to the absence of direct evidence. It is true that stone artefacts of the prehistoric people have been found in certain places of this sub-continent which date back to the Lower Palaeolithic period, but no remarkable prehistoric human skeleton have ever been unearthed. Also, the evidences regarding the racial composition of India in historic times are equally insufficient and, therefore, the anthropologists have to face a great trouble in tracing the racial history of India. Different scientists have tried to attempt at the racial classifications as far as they could but, at all times, they have to depend on assumptions. Repeated scientific researches,

in the modern light, are needed to unveil the racial history of this sub-continent.

Sir Hebert Hope Risley attempted, first of all, at the scientific racial classification of India. He classified Indian population into seven racial types like the following—

### 1. The Turko-Iranian type

The people of this type possess broad head, fine to medium nose, which is prominent and very long. They are tall-statured, fair complexioned people with generally dark eyes, though gray eyes are also found. They have a thick beard and plenty of hair in the body. Examples of this type are the people of Baluchistan Agency and Frontier Province such as the Balochis, Brahuīs and the Afgans etc.

### 2. The Indo-Aryan type

The people of this type possess long head, long and narrow nose, fair complexion. The eyes are dark in colour. They are tall-statured people with plentiful facial hair. The Panjabi Rajputs, Jats and the Khatris of the Kashmere valley are the best examples of this type.

### 3. The Scytho-Dravidian type

The people of this type possess broad head, medium nose, fair complexion. They have scanty facial hair. The stature is medium. This type has resulted from the intermixture of two distinct racial strains—the Scythians and the Dravidians. The Maratha Brahmans and the Coorgs are examples of this type. They are found distributed in the regions from Gujarat to Coorg. The Scythian element is more prominent in higher social groups of these regions and the Dravidian features are more prominent in lower groups.

### 4. The Aryo-Dravidian type

The head is generally long with a tendency to mesocephaly. The complexion varies from lightish brown to dark. Mesorrhine and in some cases platyrrhine are generally found among this type. The stature of the Aryo-Dravidian type are shorter

than those of the Indo-Aryan type. The people of this type are found in U. P., Rajasthan and Bihar. This type has been resulted due to intermixture of the Indo-Anyans and the Dravidian type.

### 5. The Mongolo-Dravidian type

They possess broad head with a tendency to medium. The nose is variable, and it is fine to broad. The complexion is dark. The facial hair is plenty. They are medium statured people but cases of short statures are also found. This type is found in Bengal and Orissa. Bengali Brahmans, Bengali Kayasthas are the notable representatives of this type. According to Risley, this type has resulted due to the intermixture of the Mongolians with the Dravidians having some blood strains of Indo-Aryan type.

### The Mongoloid type

They are broad-headed with fine nose which in a few cases are broad. The face is flat, and the eye is provided with Mongoloid or epicanthic fold. The stature is short. The complexion is dark with a yellowish tinge. Hair on the body is scanty. The people of this type is distributed in the Himalayan region e.g., Assam, Nepal and Burma.

### 7. The Dravidian type

The head is long and the nose is broad. The nasal root is depressed. The complexion is dark. The eyes are also dark. Hair is plenty and there is a tendency to curl. The stature is short. The people of this type are found in the Southern portion of India, especially Madras, Hyderabad, southern part of M. P. and Chotanagpur. The Paniyans of South India and the Santhals of Chotanagpur present pure characteristics of this type. Risley believes that they are the original inhabitants of India, who, in course of time, have been modified by the infiltration of the Aryans, Scythians and the Mongoloids.

Risley's classification of Indian humanity has received

severe criticism from various corners. The first type i.e. Turko-Iranian has been described by Risley as round-headed men of the N. W. F. P. which indicates an incorrect declination of their physical features. In discussing the broad-headed types in Bombay Presidency Risley has given much importance on the Scythian elements in its population. But the Scythian invaders stayed there so short a period that they did not get any opportunity in spreading any remarkable influence on the ethnic elements of the said place. He also states that the broad-head elements in Bengal have been influenced by the Mongolian people. But it is difficult to say with certainty that the brachycephalic elements in Bengal and Gujarat have been derived from the Mongolian sources because of the fact that all Mongolian people do not possess broad heads. Also the epicanthic fold, a Mongolian feature, though present in some people living in Darjeeling and allied districts, is totally absent among the castes of the other parts of Bengal.

The Indo-Aryans, according to Risley, are distributed in Punjab, Rajputana and the Kashmir valley, though it is seen that the speakers of Aryan languages occupy a vast area in Indian sub-continent. Moreover, if Risley measured the people of Kashmir individually, he would have placed them in a separate group as they possessed absolutely different features. The type named Aryo-Dravidian and Dravidian are no more exact than the others. In the latter type Risley mentioned all the people living in areas extending from Vindhya Hills to the Cape Comorin and from the Aravalli Hills to the Rajmahal Hills. It is worth-mentioned that many of these people do not speak in Dravidian language and many of them exhibit such physical features which are quite different from those of the Dravidian proper. Deniker has pointed out that Risley's Dravidians are comprised of two distinct types: one with long head, medium stature and narrow nose; and the other with long head, short stature and broad nose. These two groups of people are quite different from each other so far as their

physical features, culture and origin are concerned. The second type has been described by some as Pre-Dravidian. Chanda has tried to compare this type with the Nishada who have been mentioned in the Puranas as very low statured, low topped nose, copper coloured hair and the body complexion is as black as that of crow. Risley does not mention anything about the Negrito element in India.

After Risley's classification of Indian humanity different anthropologists have attempted to classify the people of India in their own way. Giuffrida-Ruggeri made the following ethnic classification—

1. *Negritoes*—Veddass and some South Indian Jungle tribes.

2. *Pre-Dravidian* or Australoid Veddaic—Santals, Mundas, Oraons etc.

3. *Dravidians*—Telegu and Tamil speaking people.

4. *Tall dolichocephalic elements*—Todas

5. *Dolichocephalic Aryans*—(*Homo dolichomorphus*)—Indo-Afgans, Indo-Iranus etc.

6. *Brachycephalic Leucodermis*—(*Homo Indo-Europeans brachymorphus*)—Armeno-Pamiriensis, Georgianus.

A. C. Haddon, while reconstructing the racial background of India, has divided India into three main geographical regions—(1) The Himalayas, (2) the northern plains or Hindusthan and, (3) the Deccan. The ethnic elements of these three regions have been given below.

#### The Himalayan region

1. *Indo-Afgans*—The Balti of Baltisthan.

2. *Indo-Aryan*—Kanets. The Kanets of Kulu valley show a trace of Tibetan blood.

3. *Mongoloid*—In Nepal, Bhutan, Sikkim and adjacent regions.

#### The Northern plains or Hindusthan region

In this region Indo-Afgan is the main racial element. This type possesses dolichocephalic head, straight or convex

prominent nose, medium to tall stature and light-brown skin colour. The Jats and the Rajputs are the best examples of of this type.

### The Deccan region

1. *Negrito*—Some people of this region possess Negrito racial strain. The Kadars are the example of this.

2. *Pre-Dravidian*—People of this type possess dolichocephalic head, platyrrhine nose and short stature. The complexion varies from dark-brown to black. The Santals, Bhils, Gonds are the examples of this.

3. *Dravidian*—People of this type possess dolichocephalic head, mesorrhine nose and medium stature. The complexion is brownish black. Tamil Brahmans, the people of Malabar, Travancore and Cochin are the examples of this type.

### 4. *Southern Brachycephals* :

The head is mesocephalic to brachycephalic and the nose is medium. The Parava, the Paniyan of Tamil district and the fishermen of Tinnevalley coast are included in this type.

### 5. *Western Brachycephals* :

They possess broad head, long nose and tall stature. The skin colour is light brown. This type is represented by the Nagar Brahmans, Coorgs, etc. Risley called these people as Scytho-Dravidians.

Haddon's classification based on physical characters artefacts, customs, language and folk-tales. With the help of these evidences he presented his own analysis of racial elements. According to him the oldest people of India must have been the Pre-Dravidians. The Dravidians also lived in India and they have been regarded as the original inhabitants of the Ganges in Western Bengal. The Aryan-speaking people first came in this sub-continent in the second millenium B.C. At first they spread on the fertile regions of the Punjab and in due course they occupied the valleys of the Jamuna and the Ganges. But Haddon failed to clear the point regarding the

**Pre-Aryan India.** The Brachycephalic elements in India, according to Haddon, is Alpine in origin.

Baron Egon Von Eickstedt gave the following ethnic classification in relation to Indian population. His study is based on both physical and cultural aspects.

### 1. Weddid group (*Ancient Indians*)—

They are the primitive people of jungle. This group is divided into two sub groups.

(a) *Gondid*—They possess dark-brown complexion and curly hair. They are totemistic in nature and use mattock. Matriarchal influence is noticed among them. The Oraons, Gonds, Bhils are the examples of this.

(b) *Malid*—They possess dark-brown complexion and curly hair. The culture of these people is ancient with some foreign influences. The Kurumbas, the Veddas are the best examples.

### II. Melanid (*Black Indians*)

They racially form a mixed group. It is divided into two sub-groups.

(a) *South Melanid*—These black-brown complexioned people live in the most southern plains of India. They are largely influenced by matriarchal characteristics. The Yandi is the example of this.

(b) *Kolid*—These people possess black-brown skin colour and live in the north Deccan forests. The totemistic beliefs are prominent in them. Matriarchal influence is seen. The Santals, the Mundas are the representatives of this.

### III Indid (*New Indians*)

They are more advanced than the other groups in racial features. It is divided into two sub groups.

(a) *Gracile Indid*—They possess brown skin-colour and gracile appearance. They are patriarchal in nature. The Bengalis are the representative of this.

(b) *North Indid*—They possess light brown skin colour. They are patriarchal in nature. The Rajputs, the Todas are the examples of this.

#### IV. Palaeo-Mongoloid

Palayan from Wynad.

The Weddid group has been named after the very primitive Veddas of Ceylon and it comprises the bulk of the aboriginals. Von Eickstedt advocates strongly that the Weddid group is really the genuine representative of the ancient Indians. Dr. Sarkar, in the light of modern researches, has also agreed to this point.

Von Furer-Heimendorf has tried to throw some light on the racial history of India. He opines that the Dravidians came to India about the time when the Aryans entered the same country. According to him, the Dravidian speaking people entered here by sea along the western coast and settled in the southern region. At that time the Aryans had also consolidated in the northern part of the country. The original inhabitants of these two areas had been driven into the forests and hilly tracts of central India. The descendants of these people represent the tribal communities of today.

A different racial reconstruction has been attempted by Guha. His classification is based on original anthropometric measurements collected by him during the 1931 census operations. Guha has given the following ethnic classification—

1. *The Negrito*
2. *The Proto-Australoid.*
3. *The Mongoloid*
  - (a) Palaeo Mongoloid
    - (i) Long-headed
    - (ii) Broad-headed.
  - (b) Tibeto-Mongoloid.
4. *The Mediterranean*
  - (a) Palaeo-Mediterranean
  - (b) Mediterranean
  - (c) Oriental type
5. *The Western Brachycephals*
  - (a) Alpinoid



(b) Dinaric

(c) Armenoid.

6. *The Nordic.*

### THE NEGRITO

The Negritos are the first comers in this country. They all belong to the Negroid stock largely found in Africa, Melanesia, Australia and the neighbouring islands. According to Guha, the Negroids constitute the earliest racial element of India. The Kadars, the Irulas and the Puniyans etc. of South India have a Negrito strain. It has also been traced among such tribes living in the Rajmahal Hills.

These people possess short stature, dark skin colour, frizzly hair with either long or short spirals. The head is either long, medium or broad. The lips are everted and thick.

The Negritos of India resemble their Melanesian neighbour than the Andamanese or African pigmies. Von Bickstedt supports Guha and admits that a Negrito strain is existing among the Malids. But most of the distinguished anthropologists have vehemently opposed the opinion of Guha regarding the Negrito racial strain in Indian population, the details of which will be discussed later on.

### THE PROTO-AUSTRALOID

According to Guha, the Proto-Australoids constitute the second oldest racial group in India. This type is characterised by dark brown to nearly black skin, long head, broad and flat nose with a slight depression at the root, wavy or even curly hair and short stature. It is seen that almost all the tribes of the Central, Southern India belong to this type. The tribal people in western part of India and the partially Hinduised groups in the valley of the Ganges also show characteristics akin to this type. The Oraons, the Santals, the Mundas, etc. of Chotanagpur region, and the Chenchus, the Kurumbas, the Yeruvas and the Badagas of Southern India and the Bhils,

Kols of Central and Western India may be regarded as the representatives of this type.

It has been seen that these tribal folk are essentially alike the Veddas of Ceylon and the aborigines of Australia so far as their physical features are concerned. This is why all these groups have been placed under the heading Proto-Australoid. Some anthropologists disagree with Guha's view regarding Proto-Australoid. According to them, Guha has made a mistake in inclusion of the Mundas, the Hos and the Santals in the said racial type. Dr. Sarker opines that the Mundas exhibit no close affinity with the Dravidians and they appear to be recent immigrants in India. They have come to this country without women because it is seen that they have given rise to many hybrid combinations, like Kharia-Munda, Mahali-Munda, Konkpat-Munda, Oraon-Munda, Bhumij-Munda etc., which is rare in case of other tribal groups.

### THE MONGOLOID

These people entered India through the north-eastern gate at different times. They are characterised by flat face with prominent cheek bones, scanty facial and body hair, peculiar obliquely set eyes with epicanthic fold, a special feature of the Mongolian people.

The Mongoloid can be divided into two groups e.g. the Palaeo-Mongoloid, and the Tibeto-Mongoloid. The former groups, in turn, is divided into two sub-groups—long-headed and broad-headed types.

The Palaeo-Mongoloid long-headed group possesses long to medium head with bulging occiput, medium nose, short and flat face, oblique eyes but Mongolian fold is not always prominent. The complexion varies from light brown to dark. The hair is straight. This type is represented by some tribes living in the Sub-Himalayan regions, Assam and Burma Frontier.

The characteristics of the next type i.e. Palaeo-Mongoloid broad-headed, are the following—the head is broad, dark skin-colour, medium nose, marked epicanthic fold. The face is flat and short. The hair is straight with a tendency to form short

waves. The Lepchas of Calimpong, certain hill tribes of Chittagong such as the Mughas, the Chakmas etc. are the representatives of this type.

The Tibeto-Mongoloid type is represented by the Tibetans of Bhutan and Sikkim. They are characterised by broad head, long and flat face, long or medium nose, tall stature, oblique eyes with marked epicanthic fold. The absence of body hair and facial hair are marked.

### THE MEDITERRANEAN

The Mediterranean group is of three distinct types as described below.

#### (a) *The Palaeo-Mediterranean type*

These people are characterised by long head with high vault and bulbous forehead, small and broad nose, dark complexion, medium stature, narrow face and scanty body and facial hair. The representatives of this type are the Tamil Brahmans, the Nairs and the Telegu Brahmans of South India.

#### (b) *The Mediterranean type*

They possess long head and face, narrow nose, medium to tall stature, dark to olive brown complexion. The hairs on the body and face are plenty. This type is represented by the Marhatta ladies of Indore, Nambudri Brahmans of Cochin, Brahmans of Allahabad. The Bengali Brahmans sometimes show the characteristics of this type.

#### (c) *The Oriental type*

The oriental type resembles the former in all the features except the nose which, in this case, is long and convex. The representatives of this type are the Benia of Rajputana, the Chettris of the Panjab etc.

### THE WESTERN BRACHYCEPHALS

This racial group is divided into three types as detailed below.

#### (a) *The Alpinoid*

This type is characterised by broad head with round occiput, round face, prominent nose, medium stature, light skin colour,

The growth of hair on the face and body is abundant. The Bania of Gujarat, the Kathi of Kathiawar and the Kayasthas of Bengal are the representatives of this type.

(b) *The Dinaric*

They possess broad head with rounded occiput and high vault, long and often convex nose, longer face, tall stature and slightly darker skin colour. This type is found in Bengal, Orissa and Coorg. The Coorgs represent the pure type. The Bengali Brahmans and the Kanarese Brahmans of Mysore show the features of this type.

(c) *The Armenoid*

They are characterised by broad head, narrow and aquiline nose with depressed tip, tawny white skin, and short to medium stature. The true representative of this type is the Parsees of Bombay. The Bengali Vaidyas and the Kayasthas sometimes show the features of this type.

### THE NORDICS

These people probably came from the steppe lands of Central Asia, Turkeystan or a little further west of that region. It is believed that they entered India through the north-west and settled in the Punjab after driving away the peoples living there who did not accept their domination.

The characteristic features of this racial group are the following—

The head is long with arched forehead and protruding occiput, the nose is straight and high-bridged, the face is long and the complexion is reddish white. The stature is moderate to tall with robust body build. The colour of the eye is blue or grey. This racial type is found scattered all over the country. Especially, in the north and north-western region it is prominently seen among the Red Kaffirs, the Khalash of Rampur and the Pathans of Bijapur. The Nordics came to India from the north most probably through Central India.

Guha's classification is now widely used in understanding the ethnic elements of this sub-continent though he has been

criticised by the different authorities in a few points. Firstly, Guha's findings regarding the Negrito element in India have been vehemently opposed by almost the leading anthropologists, the details of which will be discussed shortly. Guha has tried to show that all the races in India are of foreign origin. Keith strongly opposes this view. He cannot believe that the evolution of various races has not taken place in the 'great anthropological paradise of India'. According to Keith, India may be an evolutionary field of the different races and, this is why, he has advocated that the eyes of the scientists should be thrown on this field directly to investigate the point.

Dr. Guha has shown that the people of India are mostly brachycephalic. He has also prepared a map of India showing the distribution of head form; it shows a sweeping distribution of brachycephaly southwards, round the both ends of the Himalayas. It is seen in Pamirs, Afghanistan, Beluchistan, Sind and from where it extends to the west and broaden out from Bombay to spread over to whole of the Deccan. From the eastern side of the Himalayas the broad headed element passes from Bhutan and Tibet and it ends in Orissa after coming through Assam and Bengal. Dr. Sarkar, from his recent study on the head forms in India, has strongly opposed the view of Guha. He is of opinion that the brachycephaly in India does not show a sweeping distribution as has described by Guha. According to him, the brachycephaly is present in some zones of India; the highest frequency of this is found in N. W. F. P. among the Kakars (76%) in Nepal, among the Limbus (82%), among the Chakmas (77%) in Chittagong Hill districts. Sarkar has described the brachycephaly of Gujarat and Maharashtra as Sclytho-Iranian in origin. He has advocated that the brachycephaly of N. W. F. P., has originated from the Pamirs; and the same elements of Nepal and Chittagong are Mongolian and Malayan in origin respectively. From his extensive field work, Dr. Sarkar proposed a classification based on cephalic index. He has suggested that India is predominantly a dolichocephalic country and composed of the following three ethnic strains.

### The Dolichocephals

In India, three groups of people are found to be associated with this form of head which have been discussed in the following lines.

#### (a) *Veddids—the autochthones of India*

The aboriginal people of India exhibit a Veddoid element in different degrees. The Veddoid owes its origin to the Veddas of Ceylon. According to Sarkar, the Veddis were widespread throughout India. It is probable that they went to Ceylon, during their wanderings, through the land bridge which was in existence in that remote period. Osman Hill's monumental work indicates that Vedda head form shows 23.1% of hyperdolichocephaly. The Uralis shows 28.7% of hyperdolichocephaly. From the beds of ancient civilization at the different parts of the country hyperdolichocephalic crania have also been excavated by the archaeologists. According to Kappers, the hyperdolichocephalic skulls of Mohenjodaro indicate Veddoid feature. Most of the tribes of Southern India exhibit Veddoid affinities. The Uralis, the Kannikars and the Muthuvans of Travancore, the Kurumba, and the Irula of the Nilgiri hills; the Chenchus of Hyderabad, and the Kadars of Cochin may be taken as examples. In the Northern region, the Males and the Pahiras represent the Veddoid type.

Veddoid strains have also been found from various regions outside India. On the Western side this element is met in Hadhramaut in Southern Arabia and in Persia. A few groups of people, such as the Sakai of Malay Peninsula, the Orang Batin, the Nias Islanders, the Toalas of Celebes and the Moi of the Indo-China Hills, living in the eastern side of India show Veddoid strain. South India may be considered as the centre of the Veddis. They appear to have been more widespread throughout the length and breadth of the country than it appears at present.

#### (b) *The Dravidians of South-India*

It is thought that the Dravidians of South India have evolved from the Veddis through various ecological changes.

The climate, environment, food habit etc. have an influence on the changes in ethnic types. Sarkar has carefully shown how changes in the physical features of a hill people take place when they come to the plains. A section the Māle of the Rajmahal Hills came down to the plain areas due to some reasons and eventually they became known as Malpaharias. These people develop certain physical features which differ from those of their parent stock i.e., the Māle.

(c) *The Indo-Aryans*

The dolichocephalic Indo-Aryans came to India about 1200 B. C. through the North-Western gate. They settled at the plains of the Indus and the Ganges, and extended up to the border of Bengal. They had a different set of language and culture. These people gradually spread over the whole sub-continent and began to mix with the autochthonous population. This intermixture, in course of time, brought many changes in the physical features.

**THE MESOCEPHALS**

The Indo-Aryans were followed by the mesocephals. The ethnic strains of these people is due to Irano-Scythians.

**THE BRACHYCEPHALS**

The brachycephalic population of India had been resulted from four different sources which have been given in the following lines. The Irano-Scythian element; the brachycephalic element from Central Asia who came to India during the prehistoric period; the Malayan, who are found in the coastal region of Chittagong and Tirunelveli; and the rest one is Mongolian.

All the classifications of the races of India are based on the different criteria. The racial composition of India is a complex problem and this has become more complicated by the various authorities who have attempted to study the race at different angles. From time immemorial the fusion of the various components of the people of India has been taking place and due this it has not been possible to evolve a reasonably

acceptable system of classification of Indian humanity. At this present stage we need a fresh technique based on modern and latest information which may help in classifying the races of India.

### THE NEGRITO RACIAL ELEMENT IN INDIA

It has been remarked by certain anthropologists that the Negritos are the earliest inhabitants of India. It was De Quatrefages who, first of all, in the year 1877, advocated the theory that the Negritos had spread their influence on the Indian sub-continent. But, even in that period, De Quatrefages had to face many objections regarding his theory. In the year 1895, V. Ball opined that the conclusion at which De Quatrefages had arrived was totally baseless. But Keane had supported whole-heartedly the opinion of De Quatrefages regarding the Negrito racial strain in India. He advocated the view that a certain submerged Negrito race, first of all, came to India most probably from Malayasia. According to him, the Veddas of Ceylon, the Kadars, the Irulas, the Kurumbas, the Vellalas etc. show Negrito racial strain. But a few years later Keane himself expressed the view regarding the fact that the woolly hair which were commonly found on the heads of the Negritos of Africa was not common in India. Lapicque also carried out an work on the Kadars of South India and found a Negrito strain in them. But after one year he changed his view on the ground that he did not find any true Negrito characteristic. Risley did not find any woolly hair in India and, therefore, he was against the supporters of the presence of Negrito element in India. Haddon supported the view of Keane, but he omitted most of the groups of the latter as being the Negrito. Haddon had also referred to an early dark Negroid race in Susiana and that might have influenced India.

Some are of opinion that the Andamanese—a Negrito stock—have played the great role in the infiltration of the Negroid elements in India. But the Andamanese were never so daring to constitute a substratum of population all over



India. Risley, in his book, 'People of India', opined that the 'Andamanese have had no share in the making of Indian population'. Major Molesworth surveyed the physical features of the Andamanese and he came to the conclusion that they are totally different from the aboriginal people of India proper. His view had also been supported by Fowler and Turner. According to these scientists, the head forms of the Andamanese differ in many respects from those of the Dravidians.

Much attention to the Negrito problem of India has been given by J. H. Hutton. He has referred the presence of woolly and frizzly hair among the Angami Nagas of Manipur and Cachar hills. Hutton has given a number of evidences in support of the Melanesian physical and cultural traits in the population of India. He has suggested that the Negrito people may be responsible for the introduction into India the cults like, the disposal of the dead by exposure, and the separation of the skull, head hunting, the cult of the fig tree etc. But the different authorities do not accept such an hypothesis of Hutton. According to Dr. Sarkar, the two photographs of the Angami Nagas in support of the presence of woolly hair in them are not clear. Also Hutton does not care to photograph a bunch of hair separately which, according to Sarkar, is essential in studying the character of hair. Hutton's evidences on cultural parallels have been criticised by Majumdar. He says that if the above cultural traits have come to India through the Melanesian people, then they must have played a greater role in the cultural life of India. But practically it is seen that the distribution of these types of cultural traits in India is limited. Also Majumdar is of opinion that the exposure of the dead, the canoe cult and the megalithic cult need not necessarily be Melanesian in origin, and the cultural parallels are not always resulted due to diffusion.

Then Guha has traced the Negrito element from among the Kadars. After examining the form of hair of the said tribe he has found 16 individuals with woolly and frizzly hair. On this ground, he has tried to establish the Negrito substratum in India. Sarkar strongly opposes this view. According to him,

Guha's inference should be taken with much care. Guha's main criteria for racial discrimination is the form of hair. This isolated characteristic is not sufficient to establish a theory like this. Ehrenfels has also supported Guha as regards the woolly and frizzly hair of the Kadars. But questions have been raised by different authorities in relation to the very nature of the hair. Sarkar opines that they have used the term woolly and frizzly hair in a very loose manner. Also the indistinct photographs have put the readers in great difficulty in assessing the exact nature of the hair. The recent researches have thrown some light to explain the sporadic character in man. The presence of woolly or frizzly hair in the Indian people is a sporadic case which takes place genetically. R. Hauschild by studying the Negro-Chinese, Negro-Indian and Chinese-Mestizo crosses in the West Indies has been able to show the difference between the genetic feature of the frizzly hair of the Negroes and the ordinary frizzly hair. From this fact, it may be said that the phenotypically similar hair may have got different genotypical feature. Therefore, Guha's inference regarding the presence of frizzly hair—a Negrito feature—among the Kadars should not be supported whole-heartedly without more scientific investigation in this line. Majumdar also has raised a point that while Quatrefages defines Negrito as brachycephalic, Guha describes the Kadars as dolichocephalic. The classification of races into groups on the basis of their range of variation in cephalic and nasal measurements has not yet been possible. Sarkar has tried, in many of his experiments, to trace the Negrito racial strain theory; but he has expressed his own failure to establish this on the basis of scientific investigation.

Aiyappan is of opinion that that the tribal people is indistinguishable from the local population. He describes these tribes as the 'flesh of our flesh'. Some very insignificant tribes e.g. the Kadars exhibit frizzly hair. The individuals with such a form of hair can be counted on finger tips.

The skeletal remains found at Mohenjodaro exhibit Proto-

Australoid features. The 15 skeletons that have been discovered and studied by Guha and Basu show two definite races. The first one possesses long head, high cranium, prominent brow-ridges and an enormous growth of the post auricular parts of the skull, but these may not be Proto-Australoid. The other type shows high narrow nose, slender bodies and smooth eye-brow ridges. It resembles the Mediterranean race. Zuckerman studied the six skulls found at Tinnevely district of South India. He described one of these six skulls as Australoid and the others as Mediterranean. From studying the Adichanallur skulls Elliot Smith finds Australoid and also an Armenoid strain. It is noted that throughout whole of India Australoid or Proto-Australoid features are common. If an assimilation of the Negrito race have ever been taken place by the Indian people, then the Negroid characteristics might have been noticed frequently from the population of Northern part of India also.

From the serological study it has also been found out that the Indian tribes do not resemble the Negroes so far as their blood groups are concerned. The Indian tribes exhibit a small B incidence, whereas the Negritos are high in B. The Australoid possess A group; most of the tribes of interior India show high A group of blood. On the other hand, the Bhils and the Mundas show the existence of B group of blood among them but in physical features they do not resemble the Negritos. It is difficult to draw a conclusion regarding the Negrito element in India on the basis of serological studies because of the lack of sufficient data. This fact is yet to be explained by further researches in this line.

In the light of our present knowledge, we may conclude that the earliest inhabitants of India were the Proto-Australoids who may have received some infiltration of African or Negrito blood in certain parts of India. But this conclusion may not be final and more researches are still to be carried out to solve the problem.

## ETHNIC NOTES ON SOME TRIBES FROM INDIA AND ABROAD

*India—the land of diverse characters—presents many tribal communities who possess different kinds of ethnic features. The anthropologists have had to face many difficulties in tracing their racial origin and physical affinities. An attempt has been made here to study the physical characteristics of some tribes of India along with a few from other countries. What do they speak regarding their ethnic nature ?*

### THE ANDAMANESE

The Andamanese of the Andaman Islands in the Bay of Bengal belong to the Negrito stock. How and when they came their island home are a matter of speculation. It has been said that these people occupied the island century or even thousand of years ago. The Andamanese were visited in the year 1893 by Louis Lapicque. He examined a kitchen-midden near Port Blair and gave a descriptive account about these people. Radcliffe-Brown opined that the islands were peopled from the region of lower Burma either by land or by sea. It probably took place in the Quaternary period when the lower Burma came in direct contact with the islands due to the fall of sea-level.

The inhabitants of the Andaman Islands exhibit skin colour which varies from bronze to sooty black. The stature is short (1·48 m). Head is brachycephalic; the hair is extremely frizzly and these grow in spiral tufts. These are seldom longer than

five inches when untwisted. The colour of the hair is black with a reddish tinge. The average cephalic index is 82. The body hair is absent or scanty. The face is broad at the cheek bones and the jaws are not projecting. The eyes are prominent. The nose is straight and sunken at the root; the lips are full but no eversion is noticed; the chin is small but not retreating. They possess a well-proportioned body with small hands.

The Andamanese are food-gathering people. They do not till the soil or keep domestic animals. The food consists of different kinds of fish, turtle, yams, pig, honey and other jungle products. The socio-economic life of these people is rudimentary.

### THE AETAS

The Aetas live in the mountainous regions of the larger islands and in some of the smaller islands of the Philippines.

The skin colour of these people is dark chocolate brown rather than black. The Aeta men possess an average height of 1.46 m. The head is brachycephalic and the hair is universally woolly; the colour of the hair varies from dark brown to black. The hair is frequently abundant on body and face. The nose is short, broad, flat, bridgeless, and provided with prominent arched nostrils. The lips are thick but not protruding. More often a pronounced convexity between the upper lip and the nose is seen.

### THE SEMANGS

A single ethnic group lives in the Malay Peninsula and it is known by many names e.g. Semang, Udai, Pangan, Hami, Menik or Mandi. This group exhibits some striking resemblances with the Andamanese.

The skin colour of these people is dark chocolate brown. The head is mesocephalic; the hair is woolly in form, and in colour it is black with a reddish tinge. Hair on face and body is scanty. The face is round, narrow and projecting. The nose is short and flattened. The cheek bones are broad and the jaws slightly project forward; the lips are thick. The average stature of the Semang is 152 cm.

They are a nomadic people and their main economy is based on food gathering. Very few of them have taken to agriculture. The food chiefly consists of yams, fish and sun-dried monkeys. They have no canoes but use bamboo rafts for drifting down stream.

### THE VEDDAS

The Veddas are mainly confined in Ceylon. They are a typical example of the Proto-Australoid racial stock. They have a close racial relationship with the primitive Australian.

They are characterized by the following physical features. The skin colour is dark brown. The hair is wavy or slightly curly; the colour of the hair is black, sometimes with reddish tinge. The head is dolichocephalic (C.I. 70.5) and the face is remarkably orthognathous. The forehead is slightly retreating with pronounced brow-ridges. The nose is depressed at the root and it is platyrrhine. The lips are thin and the chin is pointed. The stature is short.

The Veddas live on food gathering activities. The bow and arrow are their only weapons by means of which they hunt various animals from the jungles. They live in rock shelters and in simple huts made of branches and leaves of the trees.

### THE SAKAI

The Sakai live in the Southern portion of Malay Peninsula and they are the representative of the Proto-Australoid stock.

They possess the following physical characteristics. The skin colour ranges from yellowish brown to dark brown. The hair is long and it is wavy or loosely curly. The colour of the hair is black with a reddish tinge. The head is mesocephalic (C.I. 78); the face is broad with prominent cheek bones. The lips are thick but not everted. The nose is low and broad, and it is provided with spreading alae. The stature of these people is short (Average 152 cm).

These people are largely nomadic. Their agricultural pattern is very primitive. It is supplemented by the various forest products. The digging stick is their usual implement.

### THE BHILS

The original home of the Bhils is the country comprised in the hill ranges of Khandesh, Madhya Bharat and Rajputana. They are also seen in Indore and in northern part of Bombay Presidency. Racially the Bhils are a branch of the Pre-Dravidian stock.

They are short statured people with well-built body. The skin colour is dark; and the nose is broad. The nasal index varies in different areas. The hands of these people are somewhat smaller and the legs are well developed. Haddon has placed them in his cymotrichous, dolichocephalic, dark-skinned, medium or short-statured, platyrrhine group; i.e. Pre-Dravidian. But, at the sametime, he has observed that the Pre-Dravidian characteristics among some of the individuals have witnessed some modifications due to subsequent admixture.

The Bhils speak a language which is composed partly of Mundari and partly of Dravidian speech. These people are locally known as 'Beel' or warrior with bow and arrow. The Bhils are agriculturists and their main economy depends on different types of cultivation.

### THE GONDS

The Gonds are the inhabitants of the two main tracts in Madhya Pradesh. The first one is the forested wide belt of broken hills and the second is more wider and inaccessible mass of hilly region. Almost all the states and districts of this province are inhabited by this tribal folk. These people are closely allied to the Khonds of the hills of Baster, Kanker and Chandwa states of Rajasthan. They are regarded as the indigenous population of this area, and the Rajputs, Jats and Gujratis are the late comers who, in course of time, have occupied a dominant position over the tribal population.

As regards physical features, they all are little below the average size of the Europeans. They are darker in complexion in comparison to their neighbours. They possess dolichocephalic head, thick lips and wide month. The hair is

black and wavy; beard and moustache are scanty. The body is strongly built.

### THE KADARS

The Kadars are one of the tribes living in Kerala State. The Kadars of the Anaimalai Hills and mountain ranges south into Travancore exhibit the following ethnic features.

Racially the Kadars belong to the Pre-Dravidian stock with dark skin and short stature (1.577 m). The head is dolichocephalic and the nose is platyrrhine. Menon found among the Kadars the instances of frizzly hair and thick protruding lips. Dr. Guha found fourteen cases of frizzly hair among the Kadars of Cochin and Anaimalai Hill regions. On this ground he demanded Negrito racial strain in these people. He also believed in the existence of Negrito element among the aboriginals of South and Central India. In recent times Ehrenfels has studied the hair form of the Kadars and his opinion shares with that of Guha's.

Now it may be said that the accidental discovery of a few cases of spirally curved hair cannot establish the Negrito element among the people. Also it is doubtful whether frizzly hair can be taken as an essential and responsible criterion for the Negrito element. Fizzly hair is nothing but a form of wavy hair in which the waves are accentuated. In this connection it may be pointed out that Fischer has shown that woolly hair is nothing but a mutant form of wavy hair. Therefore, the presence of woolly hair alone can not be taken as a characteristic of Negrito element. No thorough scientific study on the hair of these people has yet been done by anybody. Both the former workers have not done any work on the somatic characters of the Kadars. Thurston has only studied a few somatic features of the Kadars and on the basis of his study he has denied the presence of any Negrito strain in them.

The Kadars are food gatherers. Most of the time they devote in hunting and collecting forest products. Scarcely they till the soil. Collection of wax and honey from the jungle forms an important basis of their economy.



### THE AO NAGAS

They are the members of the Naga group of people and inhabit in the Naga Hill region on the north-eastern border of Assam. The Nagas are divided into a number of units e.g. Sema Nagas, Lotha Nagas, Angami Nagas, Ao Nagas etc. Each of these units has a separate language of its own.

The Ao Nagas have a distinct average appearance of their own which distinguishes them of other units. The skin colour of the Aos varies from light to dark brown. The hair is generally wavy but in some cases it is strongly curled. Perfectly straight hair is totally absent among the Aos but it is seen in the case of the Sema Nagas. The body and face are provided with abundant hair and, in this character, the Aos differ from the Sema Nagas and approach the Konyak Nagas. The head is mesocephalic. According to Mills the Cephalic Index of the Aos is 78.8 but Haddon gives the same as 80.4. Dixon also shows his intention to include them in the brachycephalic group along with the Chakma, Mikir, Mog etc. The nose is provided with a low bridge, broad nostrils which give a flat appearance. The nasal index is 81.4. The face is broad and it shows Mongolian characteristics. The cheek bones are prominent. Mills observed distinct ruddy faces among men and women. The eye brows are short and the slits are slanting. The colour of the eyes is dark brown. The average height of the males is 5 feet 8 inches and the females are shorter than the males by about two inches.

The Ao Nagas are shifting agriculturists. They clear the forest areas and practice this type of cultivation which is locally known as *Jhum*. Youth dormitory is found among this tribe which is known by the term *Arihu*.

### THE KHASIS

The Khasis inhabit in the Khasi and Jaintia hill regions of Assam. They are Mongoloid people but Pre-Dravidian racial elements are found in them. The physical features of the Khasis have been described in the following lines.

The colour of the skin varies from dark to a light yellowish brown. The head is mesocephal. It has a high vault. The forehead is broad and the supra-orbital ridges are traceable. The eyes are medium sized and the colour is black. Eyelids are somewhat obliquely set but these are not so oblique as we find in the case of the Chinese and other Mongoloid varieties. The nose is depressed and the nasal bridge is moderately concave; the nostrils are large and prominent. The malars are prominent but are of small size. The hair is somewhat straight and black in colour. The stature is short (Average 156 cm).

The Khasis speak a language which falls under the Asiatic family. The speakers of Khasi dialect are also found in the adjoining district of Sylhet and Cachar. The Khasis appear to be Mongoloid in basic features. But they exhibit some non-Mongoloid strains resulted from the contact with other people. Dr. Guha classifies them as Palaeo-Mongoloid dolicho-mesocephal type. Haddon and some other anthropologists are of opinion that these people have some relations with the Mundas and other allied tribes of Chotanagpur speaking Mundari language with Pre-Dravidian racial strain.

The Khasis are famous all over the world for the best example of matriarchal system which is found in them. Agriculture is their main economy. Some of them also work as daily labourers in the neighbouring tea gardens. Their economic condition is more or less good. In recent times, most of them have been converted to Christianity.

### THE ESKIMOS

The Eskimos are found stretched over a vast area from north-east Greenland to the mouth of the Copper river in western Alaska. Different scholars give different views regarding the centre of dispersion of these people. Rink said that the Eskimos originated as a distinct people in Alaska, whether Boas thought that they were new arrivals in Alaska, and most probably they reached there from the east.

As regards physical features the Eskimos form a distinct

type. They are characterised by very high and long head with flat and broad face. The cheek bones are prominent. The nose is high and narrow. The eyes are provided with Mongolian features. The skin colour is light brownish yellow with a ruddy tint on the exposed regions. The stature is medium.

Some scientists are of opinion that the Eskimos show a close resemblance with the Chancelade man of Magdalenian times. They have come to this conclusion on the basis of certain physical features such as head form, face form, shape of the nose etc. But this view has been rejected by Keith. In their great and peculiar development of the jaw the Eskimos show a resemblance with the Magdalenian people but this character is also obvious in *Sinanthropus*. So, according to Keith, no close affinity is seen between the Eskimos and the Chancelade man. The Eskimos possess shovel-shaped incisors which indicate that they may be grouped as Mongoloid, as this particular character is commonly met with this division of mankind. There are other type of Eskimos who are known as 'blond Eskimos' found in Victoria Islands. According to Stefansson, they are most probably the mixed descendants of Scandinavian ancestors. These people had come there from West Greenland.

The Eskimos practice food-gathering economy. They mainly live on seals and other animals living in that arctic climate. During winter months they live in snow houses, and in summer times they build skin tents.

### THE TODAS

The Todas live on the Nilgiri Hills of South India. They are a problem to the anthropologists regarding their racial affinity. The Todas present a feature which is quite different from their immediate neighbours. The time of arrival of this anomalous group to this part of India is still in the dark.

The Todas possess tall stature (67"), rich brown colour which is lighter than most of the Dravidians of South India. The men possess thick beards and much hairs on the body. The

head is dolichocephalic (C. I, 73.3); the nose is prominent and straight (N. I, 74.3). The ethnologists give different opinions as regards the ethnic position of the Todas.

According to Raggeri, they are termed as tall-dolichocephal. Miss Seligman is of opinion that the Todas have much similarity with that of the Nambudri Brahmans of South India so far as their physical features are taken into consideration. It is suggested that the Nambudri Brahmans have migrated from the North in the 4th or 5th century of the present era. Dr. Rivers has tried to establish a link between the Todas and the tribes of Malabar and Travancore. De Quatrefages grouped the Todas with the Ainus of Japan. Keane also supports this view. Deniker places the Todas in the Indo-Afghan race. The Todas, on the whole, cannot be fitted correctly with any of the racial type found in India. From his recent studies on this problem, Prince Peter of Greece have come to the conclusion that they have cultural connections with Sumeria.

The Todas of the Nilgiri Hills present a classic example of pastoral life. They do not till the soil or engage in any prominent handicraft. Their economic activity is centered round the buffaloes—their only domestic animals. The Todas practice polyandry and, for this reason, their social life is very much interesting to the students of social sciences.

### THE ORAONS

Roy Bahadur S. C. Roy traced the original home of the Oraons in South India, where they were habituated in dwelling in caves and rock-shelters, and used to subsist on jungle roots and tubers. He came to this conclusion by finding out the close similarity between the Kurukh language of the Oraons and the Tamulian languages. Due to various forces the Oraons were compelled to go eastward along the central range of hills where they evolved a primitive civilization with agriculture as main pursuits and thence they moved towards Northern direction and finally settled in Chotonagpur region.

The Oraons are below medium or short-statured people.

They possess dolichocephalic head (75.4), platyrrhine nose (86.1) and dark-brown complexion. The hair is coarse with a tendency to curl, and the colour is black. The eyes are of medium size and the colour of the iris is dark. There is no obliquity in the eye-lids. The nose presents a slight depression at the root. The jaws are seen slightly projected and the lips are thick.

As regards physical characteristics the Oraons may be classed with the other Pre-Dravidian or Australoid tribes e.g., the Mundas, the Kolis and the Santals. The Oraons are settled agriculturists and they practice the different methods of cultivation in the undulating plateau of Chotonagpur. Some of them have migrated to the tea gardens of Assam and to the Sundarban areas to work as labourers in these areas where they gradually have developed a different mode of living in the new surroundings.

### THE SANTALS

The Santals constitute one of the biggest tribe in India, who are found concentrated over a large tract of land which falls within the boundaries of Bengal, Bihar and Orissa. They belong to the Kolarian branch of Pre-Dravidian racial stock. According to Dalton, the Santals colonised parts of Hazaribagh and parts of Birbhum districts in a very early period. From those colonies they, in course of time, migrated to the different directions and formed the modern Santal groups.

As regards physical features, the Santals may be regarded as typical examples of the pure Dravidian stock. They have skin colour which varies from dark to very dark brown. The head is dolichocephalic with a high vault and narrow forehead. Face varies from Euryprosopic to Mesoprosopic. The mouth is large with thick, sometimes projecting lips. The eyes are full and not oblique. The nose is broad and flat (N. I. 88.8) with depressed root. The hair is coarse, black and occasionally curly. They possess scanty beard. The stature is short or medium (usually 157.7 cm. to 161.4 cm).

Bodding finds a Negroid element among the Santals. He has observed frizzly hair among some of the individuals. Hrdlicka has also supported this view. A Mongolian mixture has also been suggested by the prominence of the cheek bones. Ruggeri termed them as 'Australoid-Veddio.' Peter Schmidt, on the basis of language they speak e.g. Kolarian, has drawn a relationship of these people with the 'Austro-Asiatic' group. But observing the whole physical characteristics, it is better to consider these people as members of the Pre-Dravidian group however much they have been modified by various admixtures in different environment.

The Santals are well-known agriculturists. A section of them have migrated to the tea gardens of Assam and have taken up various jobs there. Some of them are engaged in the different coal mines of Bengal and Bihar to work as pick-miners and coal-cutters.

### THE ARUNTAS

The Aruntas are found in the North Central Australia. As regards their physical features, they may be taken as fairly representatives of the Australian branch of the Melanoderma.

They possess well-proportioned bodies. The head is long with a cephalic index slightly smaller than 75. The hair is wavy and the colour of which is blackish. The forehead is retreating. The nose is broad and the root of which is depressed. The supra-orbital region is prominent. The colour of the skin is chocolate brown and the stature is 166.3 cm. in male and 156.8 cm. in female.

The languages of these people have little affinity, so far as the grammar or vocabulary is concerned, with those of the tribes living in east, south and western regions. But the heterogeneous linguistic stock of North Australia show certain resemblances. Some authorities are of opinion that the Australians have close resemblances with the Neanderthals of Western Europe. They are considered to be the present day representatives of the Neanderthals. It is true that the Australians exhibit certain characteristics of Neanderthal man. But

certain special Neanderthaloid features e.g. the stumping posture, the prominence of the superciliary ridge, the recession of the frontal bone are not found among the Australians. After studying the physical features of these people in details it may be said that they have close affinity with some of the Indian tribes such as the Hos, the Mundas, the Santals and the Veddas of Ceylon.

The Aruntas live on hunting and fishing. They are divided into a number of local groups, each group is known after an animal or plant. Each local group occupies a territory over which it exercises complete control regarding hunting and fishing.

PART FIVE

# PRACTICAL METHODS



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## ANTHROPOMETRY

*It has already been cleared in the previous discussion that the human populations inhabiting in the different geographical regions differ in various physical features to a greater or lesser degree. Scientific study of these differences can only be conducted with the help of anthropometry which includes measurements that are taken on both skeletons and living human bodies. The anthropometrical study should be made correctly as far as possible. What are the procedures for taking correct measurements?*

### ITS SCOPE AND OBJECTS

Anthropometry may be defined as 'the conventional art or system of measuring the human body and its parts' (Ales-Hrdlicka). The measurement of the skull and the other parts of the skeleton are separately known as the *craniometry* and *osteometry* respectively. The system of measuring the various parts on the living human body is known as the *Somatometry*.

The system of the measurement of the human body or the anthropometry is a sum-total of the result of the various classes of workers with different motives. It is practised for the following purposes :—

- (1) In the fields of medical and surgery.
- (2) Selection of Military personnel.
- (3) Industrial purposes.
- (4) Detection of the defects in the body and their correlations.

- (5) Criminal and other investigations.
- (6) Eugenic purposes.
- (7) Various scientific analyses and investigations.
- (8) In Life Insurance.

The importance of anthropometry has now been recognised by the various classes of people and, therefore, it can not be called as the 'measurement for the sake of measurement'. During the last World War, anthropometry had abundantly been used for identification of the war dead. The Air Forces of the various parts of world have been taking the help of anthropometry to serve their various purposes. During recent times, Prof. Hooton have taken the help of anthropometry in studying the seating accommodation in trains and in the improvement of clothing size of the women and children.

The anthropometry helps the visual observer to human body to be more accurate and more scientific. Visual observation can not be relied upon as it varies from person to person. Hence, anthropometry is the only science to study the human beings correctly. Its ideal function must be the complete elimination of personal bias and collection of correct data. In order to reach the proper destination, the measurer should have undergone a proper training in the art of measuring the human body, and in the manipulation of the instruments.

## MEASUREMENTS ON THE LIVING SOMATOMETRY

Measurements on the living human body may be taken in the laboratory, in educational or certain other institutions, or in the field. In the former two cases the investigator will not find any major difficulty in taking the measurements as in these places he will get much opportunities in letting the subjects know the aim and purpose of the measurements. But when an investigator sets out in the field to record the different measurements of the bodily parts of the rural and especially

the tribal people, he faces a great trouble. The rural people will, naturally, try to avoid these 'troubles' and run away from the investigator. In this case, it will be the first hand duty of the investigator to recruit some elderly and prominent persons of the locality and explain to them the real aim and purpose of these measurements. In due course, he will be able to establish rapport with his subjects and by this he will overcome all the difficulties. However, an investigator should be modest and gentle all through the time.

### INSTRUMENTS

The success of the investigator lies in the proper acquaintance with the different instruments designed for this purpose. These should be handled in a cautious way and should be checked properly before use. The nature of various scales on the different instruments should be well understood. Otherwise, it will give erroneous conclusions. Before going to discuss the measurement techniques it is better to describe, in details, the various instruments used in measuring the living human body.

The following are the essential types of instruments for somatometry :—

#### (1) Martin's Sliding Caliper.

It consists of a main flattened steel plate, graduated in millimeters on its two sides, and two cross-bars. The crossbar at the top is fixed and the other crossbar, which is fixed on a movable casket, can be slid up and down. There is a screw at the middle of the casket by means of which the movement of the second crossbar, as well as the casket can be checked. The zero mark of the main plate begins just at the end of the fixed crossbar and it is continued downwards upto 200 mm. From the base of the said plate, another scale runs starting from zero point and goes upto the length of 50 mm. upwards. Each crossbar is provided with two ends—one is blunt and the other is sharp and pointed. The blunt end is meant for the measure-

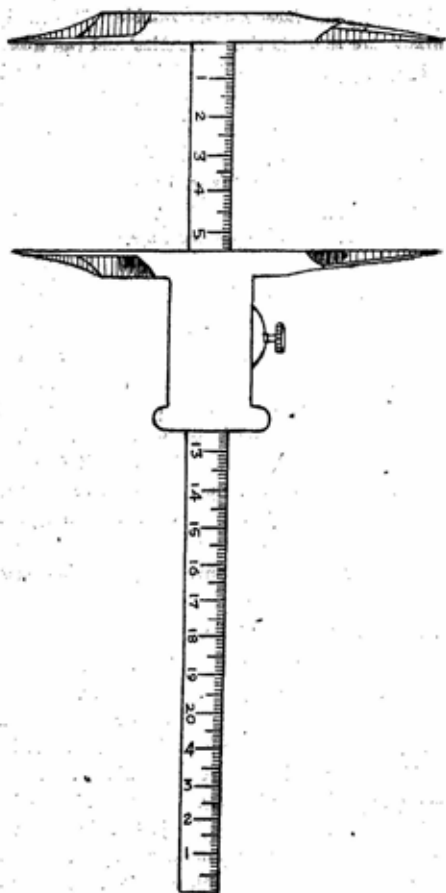


Fig. P. 1. Sliding Caliper

ments on the living beings, while the sharp end is used on the skulls and bones.

The scale at the lower region of the plate is used for certain depth measurements. In such case, a change is to be made in arranging the instrument. The movable casket should be fitted on the main scale in the upside-down position.

*Manipulation*

At the time of measurement by means of this instrument, hold its main steel plate by the palm and four fingers. The thumb will guide the sliding casket in upward or downward position. Use your left hand in tracing the landmarks.

(2) **Martin's Spreading Caliper.**

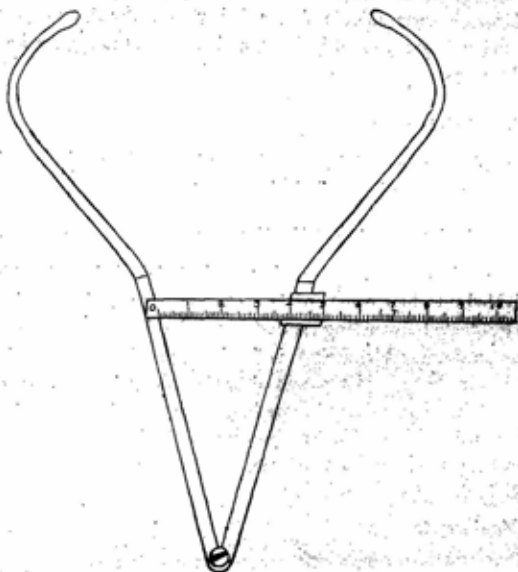


Fig. P. 2. Spreading Caliper

This instrument is composed of two curved arms, which

rotate on a screw at the straight ends. The tips of the curved arms are provided with small knobs. The ends of some instruments are pointed and these are used in taking measurements on skeletal parts. There is a straight scale, graduated in millimeters, fixed at the middle of the left curved arm, which runs along separate piece attached to the right-hand arm by pivots. A screw at the backside of the said metal piece controls the movement of the two arms and graduated scale of the instrument.

#### *Manipulation*

At the time of taking measurement, hold the two arms of the instrument in such a manner as the curved portions remain in between your middle finger below and the thumb above. The index fingers should be bent and their tips touch the knob of the arms.

#### (3) Pelvimeter

Pelvimeter is a larger variety of spreading caliper. In this case the scale is double in length.

#### (4) Anthropometer of Martin

It consists of a two-metre long rod of nickelled steel, which is divided into four equal parts. On one side of the rod there is a graduated ascending scale from the bottom to the top where an immovable socket is fixed. There is another socket which can be moved up and down on the rod. These two sockets bear two graduated cross-bars, each of which is provided with a pointed tip. The main purpose of the anthropometer is to take the long measurements on the various parts of the body from the ground.

#### *Manipulation*

Place the anthropometer on the ground in a vertical position by the side of the subject and hold the rod by your one hand. Locate the landmark and by raising the movable socket

by the other hand apply the pointed tip of the crossbar against



Fig. P. 3. Anthropometer

the point and take down the measurement at the upper end of the window of the movable socket.



### (5) Rod Compass of Martin

The Rod Compass is not a separate instrument but a part of the former. The upper segment of the anthropometer with its two sockets and crossbars is known as the Rod Compass. It has a descending scale, the zero of which begins at the lower end of the fixed socket. The Rod Compass is used for taking certain measurements where the Sliding Caliper fails.

#### *Manipulation*

Hold the main rod of the instrument between your palm and four fingers of the right hand, and use the thumb for moving the socket up and down. Locate the landmark by the left hand. For measuring certain horizontal lengths, the Rod Compass is to be used in a different way. In these cases hold the instrument in such a way as the main rod remains in horizontal position. Grasp the movable socket by means of your palm and fingers, but the index-finger should be stretched and rest on the crossbar. Similarly, the right index-finger will support the crossbar of the fixed socket.

There are certain parts on the human body which are difficult to measure by the straight crossbars of the anthropometer as these can not reach the landmarks. In these cases two curved crossbars are used.

### (6) Parallelometer

This instrument is especially designed for the measurement of the auricular height of the head. It consists of three graduated metal bars. Out of these three bars two are of equal length and at the each end of these latter two bars there are caskets fitted with the screw. With the help of these caskets and screws the third longer bar can be adjusted horizontally. The vertical bars can be slid backward and forward on the horizontal bar for the purpose of measurement. On the vertical bars there are two

movable cross-pieces with projected ends, and these can be guided up and down.

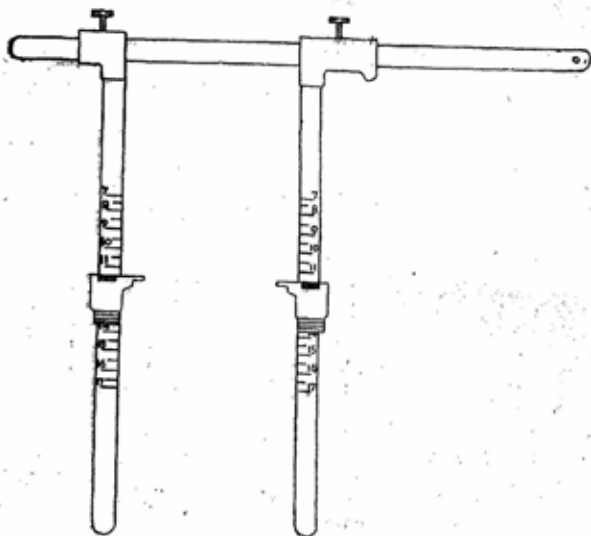


Fig. P. 4 Parallelometer

#### *Manipulation*

At the time of measurement the horizontal bar of the instrument should be placed against the vertex. The two vertical bars should then be brought against the temporal regions by guiding these backward and forward as the case may be. The sliding cross-pieces of the vertical bars are then applied on the trignon points.

#### 7) Steel Tape

The Steel Tape is used for the measurement of circumference of various parts of the body. It is flexible and graduat-

ed on both the sides and is wound in a metal case. It can be drawn out by pulling the end. The metal case is provided

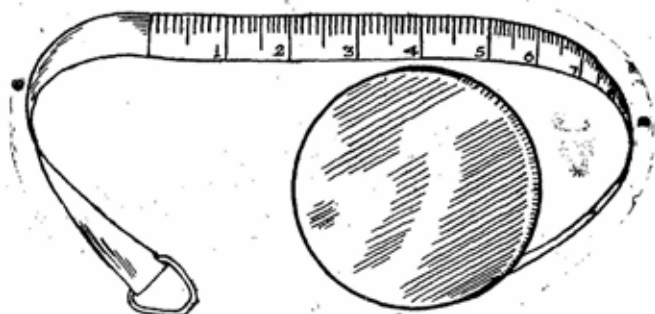


Fig. P. 5 Steel Tape

with a push-button, which helps in winding the drawn-out tape.

#### 8) Skin Pencil

It is better to mark the landmarks on the human body by skin pencil before taking the measurement. For this purpose a dermatograph pencil is used.

#### 9) Weighing Machine

For taking the weight of the subject a weighing machine is essential. Each anthropological laboratory is provided with one or more stationary weighing machines. During field-work, a good portable weighing machine is helpful.

#### 10) Lens

A lens is essential for the workers for certain somatological observations. It is helpful in examining the iris, mid-digital hair, etc.

### THE LANDMARKS

According to Ales Hrdlicka, a landmark may be defined 'as nearly as possible' a definite point from or to which to

measure'. In anthropometry the landmarks are of utmost importance. The different types of landmarks on the human body are given below.

### ON THE HEAD AND FACE

1) Vertex (v)—It is the highest point on the top of the head in the mid-sagittal line.

2) Glabella (g)—It is the most prominent point or space in the median plane between the two eye-brows.

3) Trichion (tr)—It is the meeting point on the median plane of the hair limit.

4) Opisthocranion (op)—It is the most posterior point on the back of the head in the mid-sagittal line.

5) Inion (i)—It is a point at the meeting region of the superior nuchal lines in the mid-sagittal plane. This is the summit of the external occipital protuberance.

6) Euryon (eu)—It is the lateralmost point on the parietal side of the head. It is to be found out by measuring the maximum breadth of the head.

7) Frontotemporale (ft)—It is the medialmost point on the temporal line.

8) Tragion (t)—It is a point on the junction of the anterior, inferior root of the helix with the tragus cartilage.

9) Nasion (n)—It is a point on the junction of the frontal with the nasal bones. But in the case of the living the nasal bones can not be seen. Here the measurer should feel the point by the help of his finger.

10) Subnasale (an)—It is a meeting point of the lower surface of the nasal septum and the upper lip.

11) Alare (al)—It is the most projecting point on the lateral wings of the nose.

12) Pronasale (pru)—It is the farthest point on the tip of the nose.

13) Prosthion (pr)—It is the lowest point on the border of the gum between the two medial incisors.

14) Stomion (sto)—It is a point just on the junction of the two lips in the median plane.

15) Gnathion (gn)—It is the lowest point of the mandible in the median plane.

16) Orbitale (or)—It is the lowest point on the lower border of the eye socket.

17) Zygion (zy)—It is the lateralmost point of the zygomatic arch.

18) Gonion (go)—It is a point on the angle of the mandible formed by the body and the ramus.

#### ON THE TRUNK AND EXTREMITIES

1) Acromion (a)—It is the lateral point of the acromial border of the scapula.

2) Radiale (r)—It is a point on the border of the radius bone with the arm in hanging position.

3) Styliion (sty)—It is a point on the styloid process of the radius.

4) Dactyliion (da)—It is a point on the curved top of the middle finger.

5) Metacarpale radiale (mr)—It is the radialmost point on the head of the Os Metacarpale II.

6) Metacarpale Ulnare (mu)—It is the ulnarmost point on the head of the Os Metacarpale V.

7) Iliospinale (is)—It is the forward and backwardly directed point on the ventral face of the iliac spine.

8) Tibiale (ti)—It is a point on the middle of the medial border of the head of the tibia.

9) Sphyrion (sph)—It is a point on the tibial malleolus. The distalmost point should be taken into consideration.

10) Pternion (pte)—It is the hindermost point of the heel.

11) Acropodion (ap)—It is the most forwardly projecting point on the top of the first or second toe.

12) Metatarsale tibiale (mt)—It is the medialmost point on the first metatarsal.

13) Metatarsale fibulare (mf)—It is the lateralmost point on the fifth metatarsal.

### MEASUREMENT TECHNIQUES

The anthropometric measurements on the living human being can be divided into two parts—measurements on the head and face, and those on the trunk and limbs. First of all, we shall discuss the various measurements on the head and face.

#### *The subject*

Before taking the measurements, the subject should be asked politely by the measurer to remove his excessive clothings, shoes, and head-dress, if any. He then be requested to sit on a stool for taking measurements on the head and the face.

#### *Precaution*

The measurer should be alert in keeping the subject in proper position. He should always try to find out the proper landmarks to get a clean work. By regular practice the handling of the instruments and accurate reading of the scales must be mastered. Carelessness, defective eyes, inaccurate instruments and poor lighting result various mistakes in the study. These factors must be avoided by the measurer in order to get correct result.

#### 1) Maximum Head Length

*Instrument*—Spreading Caliper.

*Landmarks*—Glabella to Opisthocranium.

*Method*—First of all, hold the two arms of the caliper by your two hands and stand at the left side of the subject. Fix the tip of the left arm of the caliper on the glabella and apply



Fig. P. 6 Head length

the right arm of the caliper, holding it by means of your right hand, on the occipital bone. Try to find out the maximum point on the occipital bone by moving the right arm up and down on the median line. The maximum measurement should be noted down.

*Precaution*—Caution should be taken to see that the right arm of the caliper is moving on the median line.

## 2) Maximum Head Breadth

*Instrument*—Spreading Caliper.

*Landmarks*—Euryon to Euryon.

*Method*—Stand at the back side of the subject holding the two arms of the caliper just as you have done in the above measurement and apply these on the two parietal sides of the head. Find out the maximum measurement by moving the instrument forward, backward, upward and downward directions. The maximum measurement should be noted down.

*Precaution*—Always watch that the two ends of the caliper are moving in a horizontal plane and at right angles to the maximum head length.

## 3) Auricular Height of Head

*Instrument*—Parallelometer.

*Landmarks*—This measurement should be taken from the highest point of the vertex to the trignon.

*Method*—Hold the lower regions of the vertical bars of the instrument by means of your two hands and apply the horizontal bar against the vertex of the subject. Then try to bring the two vertical bars near the two temporal regions of the subject and apply the projected ends of the cross-pieces against the trignon points by moving these upwards and downwards by the help of your thumbs.

The measurement of the auricular head height can be taken by the Rod Compass also according to the following procedure.

*Method*—The subject should be requested first to keep his head in the normal position with the eyes directed forward. Stand at the left side of the subject holding the Rod Compass by your right hand. Pull out the upper crossbar of the instrument to its fullest extension. The lower crossbar should be drawn short. Place the upper arm of the crossbar on the vertex and then try to touch the measuring point of the lower arm on the trignon by raising or lowering it. Read out the difference between these two points from the scale of the instrument.



*Precaution*—At the time of measurement watch cautiously that the tubular rod of the instrument remain in vertical position. The upper crossbar should be always horizontal.

#### 4) Minimum Frontal Breadth

*Instrument*—Spreading Caliper.

*Landmarks*—Frontotemporale to Frontotemporale.

*Method*—It is the least breadth measurement of the forehead. Stand in front of the sitting subject by holding the tips of the arms of the caliper in a manner similar to that of the head length. Try to find out the minimum breadth of the bony temporale crest on the temporal line and record the measurement.

*Precaution*—Care should be taken to see that at the time of measurement the ends of the caliper may not slip down below the temporal crest.

#### 5) Bizygomatic Breadth

*Instrument*—Spreading Caliper.

*Landmarks*—Zygion to Zygion.

*Method*—Stand in front of the subject, seated on a stool, by holding the two ends of the caliper arms by means of your two hands. Apply the two ends of the instrument on the zygomatic arch and find out the maximum measurement by guiding the instrument backwards and forward. Note down the maximum breadth from the scale of the caliper.

*Precaution*—Always watch that the tips of the caliper remain in the transverse plane at the time of taking the measurement.

#### 6) Bigonial Breadth

*Instrument*—Spreading Caliper.

*Landmarks*—Gonion to Gonion.

*Method*—Hold the ends of the caliper by means of your thumbs and fore-fingers and try to locate the two gonion points with the help of your index-fingers. Then apply the two ends of the instrument against the landmarks and read out the measurement from the scale.

*Precaution*—Special care should be taken to see that the two ends of the instrument must remain in the transverse plane while measuring.

7) **Total Facial Height**

*Instrument*—Sliding Caliper.

*Landmarks*—Nasion to Gnathion.

*Method*—Hold the instrument by your right hand and kneel down before the subject. Try to find out the nasion point by palpation with the help of your fingers. You will

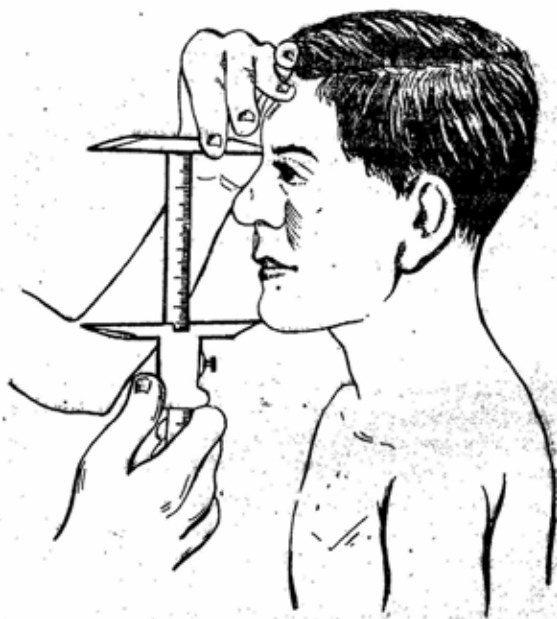


Fig. P. 7 Total Face Height

surely feel a transverse groove just beneath the skin which is the fronto-nasal suture. After getting the proper point apply

the blunt end of the upper fixed crossbar of the caliper against it and hold it by means of your left hand. Then by lowering down the other movable crossbar by the right hand, apply it just on the gnathion point. Record the measurement from the scale.

*Precaution*—See that the subject's mouth is closed and the teeth are pressed against each other. Always use the blunt end of the caliper in all types of measurement.

#### (8) Upper Facial Height

*Instrument*—Sliding Caliper.

*Landmarks*—Nasion to Prosthion.

*Method*—Hold the instrument in a manner similar to that of the previous measurement, keeping the blunt end of the fixed crossbar on the nasion. Then by raising the lower crossbar, try to apply it against the prosthion point, i.e. at the lowest projection of the gum between the upper middle incisors. Note down the difference from the scale.

*Precaution*—Do not take this measurement on the subjects who have lost the upper middle incisors or who have taken artificial dental plates.

#### (9) Nasal Height

*Instrument*—Sliding Caliper.

*Landmarks*—Nasion to Subnasale.

*Method*—Apply the fixed crossbar of the caliper against the nasion point and, by sliding the lower crossbar, adjust it on the subnasale at the lower border of the nasal septum. Read out the measurement and record it.

*Precaution*—If the tip of the subject's nose hangs more downwards, the measurement should be taken by holding the caliper sideways instead of in the middle line of the nasal bridge.

#### (10) Nasal Breadth

*Instrument*—Sliding Caliper.

*Landmarks*—Alare to Alare.

*Method*—Apply the fixed crossbar of the caliper against

the right alare of the subject's nose and hold it by your left hand. Then place the movable crossbar on the other alare by sliding it as necessary by your right hand. Record the measurement.

*Precaution*—Do not apply pressure on the nasal wings by the instrument. The subject should be asked to keep the nasal wings in natural position.

#### (11) Depth of Nose

*Instrument*—Sliding Caliper. In the case of this measurement the movable crossbar with its holder should be adjusted upside down as directed.

*Landmarks*—Pronasal to the meeting point of the nasal wings on the cheek.

*Method*—Apply the zero point of the scale on the most posterior point on the line projected from the left wing of the nose, and then place the flat end of the movable crossbar on the pronasal point. Record the measurement.

*Precaution*—The main rod of caliper should remain parallel to the median line at the time of measurement.

#### (12) Ear Length

*Instrument*—Sliding Caliper.

*Landmarks*—Highest point on the helix to the lowest point of the ear lobe.

*Method*—Apply the fixed cross bar of the caliper on the uppermost point of the helix of the ear by placing the instrument against the side of the subject's head. Then raise the lower movable bar until it just touches the lowermost point of the earlobe.

*Precaution*—Do not exert pressure on the ear lobe in order to avoid incorrect measurement.

#### (13) Ear Breadth

*Instrument*—Sliding Caliper.

*Landmarks*—Base of the ear to the posterior border of the ear cartilage.

*Method*—The fixed bar of the caliper is to be placed at the

\*base of the ear ; the main bar of the caliper will remain above the ear. Slide the movable bar until it touches the most projecting point on the ear cartilage. Record the measurement.

*Precaution*—Avoid all types of compression on the ear cartilage.

#### 14) Circumference of the Head

*Instrument*—Steel Tape.

*Method*—Hold the zero point of the tape on the glabella by your left hand and then apply the tape around the whole projecting surface on the back of the head by your right hand. Join the two ends at the glabella region and read out the circumference from the scale.

*Precaution*—Be careful about the correct position of the tape around the head.

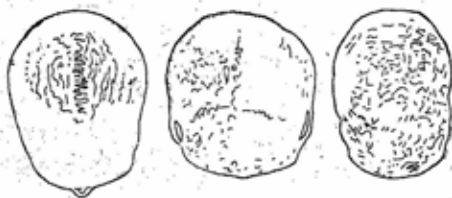


Fig. P. 8. Different types of Skull. Left, Mesocephalic ; Middle, Brachycephalic ; Right, Dolichocephalic.

### INDICES

#### What is an index ?

By measuring the different aspects of the head and face of man we get the various features of shape. These are expressed by comparisons of different dimensions, such as, length and breadth of the head, length and breadth of nose, etc. In this way, we find during the measurement of the head of a given subject, number of different ratios which express accurately the form of the head. This ratio is known as an *index*.

*Its rule*—The significance of an index is to find out what percentage the shorter of the two measurements is of the longer measurement with which it is being compared. In order to find out an index, arrange the shorter measurement as numerator and longer as denominator which give rise to a fraction. This fraction is then to be multiplied by 100.

The formulae of various indices and their classifications are given below—

$$1) \text{ Length-Breadth Index} = \frac{\text{Maximum Head Breadth}}{\text{Maximum Head Length}} \times 100$$

Hyperdolichocephal	—	—	70.4
Dolichocephal	—	70.5	75.9
Mesocephal	—	76.0	80.9
Brachycephal	—	81.0	85.4
Hyperbrachycephal	—	85.5	+

$$2) \text{ Length-Height Index} = \frac{\text{Auricular Height of Head}}{\text{Maximum Head Length}} \times 100$$

Chamaecephal	—	—	57.6
Orthocephal	—	57.7	62.5
Hypsicephal	—	62.6	+

$$3) \text{ Breadth-Height Index} = \frac{\text{Auricular Height of Head}}{\text{Maximum Head Breadth}} \times 100$$

Tapeinocephal	—	—	78.9
Metriocephal	—	79.0	84.9
Acrocephal	—	85.0	+

$$4) \text{ Facial Index} = \frac{\text{Facial Height}}{\text{Max. Bizygomatic Breadth}} \times 100$$

Hypereuryprosop	—	—	78.9
Euryprosop	—	79.0	83.9
Mesoprosop	—	84.0	87.9
Leptoprosop	—	88.0	92.9
Hyperleptoprosop	—	93.0	+

$$5) \text{ Nasal Index} = \frac{\text{Nasal Breadth}}{\text{Nasal Height}} \times 100$$

Hyperleptorrhine	—	—	54.9
Leptorrhine	—	55.0	69.9

Mesorrhine	-	70.0	-	84.9
Platyrrhine	-	85.0	-	93.9
Hyperleptorrhine	-	100.0	+	

$$6) \text{ Nasal Elevation Index} = \frac{\text{Depth of Nose}}{\text{Nasal Breadth}} \times 100$$

$$7) \text{ Ear Index} = \frac{\text{Ear Breadth}}{\text{Ear Length}} \times 100$$

## MEASUREMENTS OF THE TRUNK AND LIMBS

In order to take these measurements the subject should be requested to stand up and he should wear minimum clothings. The subject should also be asked to put off his shoes, socks, and head dress, if any. Note down the age of the subject.

### The Measurements

#### 1) Stature or Height Vertex

*Instrument*—Anthropometer.

*Landmarks*—From floor to Vertex.

*Method*—Ask the subject to stand as erect as possible. His arms should rest on the sides, the heels touch one another and the eyes should be directed upon the horizon which helps in keeping head in natural condition. Place the anthropometer in front and in the median line of the subject. Holding the anthropometer by one hand you just lower the sliding sleeve with the crossbar until it touches the vertex of the head. Record the measurement.

*Precaution*—Always take care regarding the vertical position of the main rod of the measuring instrument. The hairs of the subject's head sometimes give obstacles in getting correct result. Therefore, it should be carefully avoided.

#### 2) Height Tragus

*Instrument*—Anthropometer.

*Landmarks*—From floor to Tragon.

*Method*—Ask the subject to stand just he has done in the previous measurement. Place the anthropometer on the right

side of the subject and apply the end of the sliding crossbar against the tragon point. Read out the measurement.

*Precaution*—Always remain alert regarding the vertical position of anthropometer.

### 3) Height Acromion

*Instrument*—Anthropometer.

*Landmarks*—From floor to Acromion.

*Method*—Holding the anthropometer in the manner similar to that of the previous measurement place the sliding crossbar end against the acromion point and take down the measurement.

*Precaution*—Vertical position of the rod should be taken into account.

### 4) Height Radiale

*Instrument*—Anthropometer.

*Landmarks*—From floor to Radiale.

*Method*—Apply the tip of the movable crossbar of the anthropometer against the Radiale point and take the difference from the floor.

*Precaution*—Keep the rod in vertical position.

### 5) Height Stylium

*Instrument*—Anthropometer.

*Landmarks*—From floor to Stylium.

*Method*—Hold the anthropometer just like the above measurement by one hand and find out the stylium point by the other. Then lower the sliding crossbar and apply its tip on the required landmark. Read out the measurement.

*Precaution*—The rod should be kept in vertical position.

### 6) Height Dactylium

*Instrument*—Anthropometer.

*Landmarks*—From floor to Dactylium.

*Method*—Place the tip of the crossbar of the anthropometer on the dactylium point and take down the height from the ground.



*Precaution*—Keep the anthropometer vertical. The palm of the subject should be stretched properly.

#### 7) Height Iliospinale

*Instrument*—Anthropometer.

*Landmarks*—From floor to Iliospinale.

*Method*—Find out the Iliospinale point by your left index-finger while the right hand holds the anthropometer. Then place the tip of the movable crossbar on the required landmark and read out the height from the floor on the scale.

*Precaution*—Keep the anthropometer in vertical position.

#### 8) Height Tibiale

*Instrument*—Anthropometer.

*Landmarks*—From floor to Tibiale.

*Method*—Holding the anthropometer by your right hand, kneel down before the subject and try to locate the tibiale point by your other hand. The subject may be asked to hold upper portion of the anthropometer cautiously. Apply the crossbar on the tibiale point and note down the measurement.

*Precaution*—Keep the anthropometer in vertical position.

#### 9) Height Spherion

*Instrument*—Anthropometer.

*Landmarks*—From floor to Spherion.

*Method*—Hold the anthropometer in the manner similar to that of the above measurement and apply the sliding crossbar on the spherion point and take down the height from the floor.

*Precaution*—Keep the instrument in a vertical position.

#### 10) Span

*Instrument*—Anthropometer.

*Landmarks*—Dactylion to Dactylion.

*Method*—Stand at the back side of the subject, who has been directed to stretch arms laterally, hold the main rod of the anthropometer horizontally. Place the anthropometer on the body of the subject just below the shoulder level and ask him to keep his right middle finger on the zero point, i. e. just at the junc-

tion of the immovable holder of the crossbar with the anthropometer rod. He then be directed to move the other movable holder by his left middle finger as far as he can. Read out the difference from the lower end of the slider.

*Precaution*—See that the stretched out arms of the subject remain in the horizontal position.

### 11) Arm Length

*Instrument*—Rod Compass.

*Landmarks*—Acromion to Dactylion.

*Method*—Stand on the right side of the subject holding the rod compass by your right hand. Trace out the acromion point by the fingers of your left hand and place the upper crossbar against the acromion and by raising the other crossbar apply it against the tip of the middle finger, i. e. dactylion. Take down the measurement from the scale.

*Precaution*—The subject's arm should rest on the side of the body and the palm should be stretched properly.

### 12) Length of the Upper Arm

*Instrument*—Rod Compass.

*Landmarks*—Acromion to Radiale

*Method*—Keeping the instrument in a position just like the above measurement, raise carefully the movable socket of the Rod Compass until the tip of the crossbar touches the radiale point. Note down the measurement from the adjoining scale.

*Precaution*—Care should be taken to see that the arm hangs alongside the body.

### 13) Length of the Forearm

*Instrument*—Rad Compass.

*Landmarks*—Radiale to Dactylion.

*Method*—Hold the instrument as you have done in the above measurements and apply the upper crossbar on the Radiale point. Then slide the lower crossbar until it touches the tip of the middle finger. The measurement should be noted down from the scale.

*Precaution*—The arm of the subject should remain attached against the body and the palm should be stretched out.

## 14) Hand Length

*Instrument*—Sliding Caliper.

*Landmarks*—Stylian to Dactylian.

*Method*—Keep the extended palm of the subject on your left hand and draw a line from the stylian point at right angles, to the length of the hand by a skin pencil. Then apply the tip of the fixed crossbar against the stylian, while the other crossbar on the dactylian point. The main rod of the instrument should remain in parallel to the mid-line of the hand. Note down the measurement.

*Precaution*—The subject should be asked to stretch out his palm and finger as far as he can.

## 15) Hand Breadth

*Instrument*—Sliding Caliper.

*Landmarks*—Metacarpale Ulnare to Metacarpale Radiale.

*Method*—Holding the palm of the subject in a manner similar to that of the length measurement you just apply the two crossbars of the caliper against metacarpale ulnare and metacarpale radiale. The difference will give the breadth of the hand.

*Precaution*—The palm of the subject should be stretched properly.

## (16) Bi-acromial diameter

*Instrument*—Rod Compass.

*Landmarks*—Acromion to Acromion.

*Method*—Stand behind the subject by holding the Rod Compass with its two crossbars retracted to a length of about 4.5 inches. Find out the two acromion points with the help of the fingers and apply the two ends of the crossbars on these two landmarks. Read out the measurement from the scale meant for the Rod Compass.

*Precaution*—Caution should be taken in finding out the acromion points and fixing the crossbars on these.

### (17) Bi-iliac diameter

*Instrument*—Rod Compass.

*Landmarks*—Two lateral points on the iliac crest.

*Method*—Stand behind the subject by holding the rod compass in a manner so that the fixed casket remain in the right hand while moving one in the left hand. The cross-bars should be extended fully. Try to palpate the most lateral points on the iliac crest by means of your fingers. On getting these you just apply two inner borders of the cross-bars against these and take down the difference from the adjoining scale.

*Precaution*—In taking this measurement the subject's clothing cause some disturbances. He should be asked to wear a thin garment in order to avoid inaccuracy. It is also difficult to find out the proper landmark of the subjects who possess bulky and fatty body. In these cases pressure should be exerted by the crossbars in order to get the definite points.

### (18) Chest Breadth

*Instrument*—Rod Compass.

*Method*—Stand in front of the subject holding the Rod Compass whose two crossbars have drawn out to their maximum. Place the more or less flattened portion of the main rod of the instrument against the subject's chest at the nipple level. The crossbars of the Rod Compass should slightly touch the sidewalls of the chest. The arms of the subject should hang down and he may be directed to hold these slightly away from the sidewalls of the chest. Take down the two measurements of the chest—one in inhalation state and the other in exhalation. Find out the mean of the two measurements and note down.

*Precaution*—The subject should be directed to breathe naturally, otherwise it will spoil all the measurements.

### (19) Chest Depth

*Instrument*—Rod Compass.

*Method*—Draw out the two crossbars of the Rod Compass fully and apply the main rod of the instrument against the left

sidewall of the chest of the subject. He should be directed to raise the left arm slightly for the convenience of the measurement. Holding the fixed casket of the Rod Compass by your left hand apply its crossbar against the chest at the nipple region. Then adjust the movable casket in such a way as to fix the other crossbar at the back just below the lower edge of the scapula. Apply slight pressure until the inner portion of the crossbar touches the lower edge of the shoulder blade. Note down the measurement.

*Precaution*—It is a difficult measurement and that is why the measurer should be careful while adjusting the measuring arms of the instrument on the proper points.

#### ( 20 ) Circumference of the Thorax

*Instrument*—Steel Tape.

*Method*—Ask the subject to raise his arms slightly and place the steel tape around his chest keeping the zero point in the front side. Holding the zero end of the tape by your left hand try to control the tape over the proper landmarks. The tape should be passed above the nipples in front and below the angles of the scapula at the back. After placing the tape in proper positions ask the subject to lower his arms. The two ends of the tape then touch each other on the front wall of the chest and these should be kept by your right hand. Ask the subject to exhale and inhale. Note the measurement in these two states.

*Precaution*—Care should be taken in placing the tape on proper points.

#### ( 21 ) Foot Length

*Instrument*—Rod Compass.

*Landmarks*—Pternion to Acropodion.

*Method*—Ask the subject to place his right foot on a plane floor. The weight of the body should fall on this. Place the Rod Compass on the medial side and the main rod which should be parallel to the inner border of the foot while the crossbars rest on the floor. Apply the two inner borders of the bars against the two landmarks and note down the measurement.

*Precaution*—Do not press the landmarks at the time of taking measurement.

### ( 22 ) Foot Breadth

*Instrument*—Sliding Caliper.

*Landmarks*—Metatarsal Fibulare to Metatarsal Tibiale.

*Method*—Apply the two blunt ends of the crossbars of the instrument against the two above landmarks and note down the measurement. This measurement will be oblique to the long axis of the foot.

*Precaution*—Be careful in detecting the landmarks before applying the instrument.

### ( 23 ) Foot Contour

Contour tracing of the foot gives much more clearer idea about the foot of the subject than the above two measurements. In doing this the subject should be asked to sit on a stool and place his right foot on a clean piece of paper. A thin pencil with a long exposed lead will be required for this purpose.

The maximum length of the foot can be taken now by drawing a line from pternion to acropodion. Draw the two different lines, one from the pternion to the middle point of the great toe and the other from the pternion to the middle point of the second toe. These two lines will form an angle at the pternion point which is known as the *Halux divergence angle*. For taking the breadth of the foot mark the two points—one at the metatarsale ulnare and the other at the metatarsale tibiale points. These two points can now be joined by a line. The interspace between the toes can also be found out easily by contour tracing.

### ( 24 ) Sitting Height

*Instrument*—Anthropometer.

*Landmarks*—From the sitting plane to Vertex.

*Method*—The subject is requested to sit on such a stool so that his thighs rest horizontally. Ask him to look at the horizon so that the position of the head will be normal. Stand

by the left side of the subject holding the anthropometer which should be placed on the sitting surface. Lower the sliding sleeve with its extended crossbar carefully until it touches the vertex of the subject's head. Take down the measurement from the adjoining scale.

*Precaution*.—Keep the rod of the anthropometer in a vertical position. Avoid inaccuracy caused by the hairs on the subject's head.

### (25) Weight

The weight of the subject should be recorded by the weighing machine in standing position. He should be provided with minimum clothing and without shoes. The time and hour should be noted down. Care also should be taken to see whether the weight of the subject has been taken after or before a meal. Do not allow the women to be weighed with heavy ornaments.

## OBSERVATIONS

The value of somatological observations can not be neglected in the science of anthropometry. It is true that these observations can not be made so accurate as we have done in the case of anthropometrical measurements. Yet it is quite possible to make these observations more or less accurate by constant and careful practice and by the consultation with the works of various authorities in this field. Now let us discuss the important somatological characteristics of the various parts of the human body.

## HAIR

### (1) Hair Colour

In determining the colour of the hair of the subject it is better to consult the hair colour chart of Fischer and Saller. In this chart thirty varieties of hair have been arranged each of which bears different colour. The subject's hair colour can best be determined by comparing these with the said chart.

## (2) Hair Form

The hair can be divided into the following groups and sub-groups as regards forms :—

(A) *Leiotrichous or Straight hair*—It can be sub-divided into the following groups—

- (i) Stretched—Thick straight hair.
- (ii) Smooth—Thin straight hair.
- (iii) Flat wavy—Waves provided with largest radius.

(B) *Cymotrichous or Wavy hair*—This type of hair can be sub-divided into the following groups—

- (i) Broad wave—Waves with smaller radius.
- (ii) Narrow wave—Strongly curved and short waves.
- (iii) Curly—Waves are deep and provided with broad spirals.

(C) *Ulotrichous or Woolly hair*—This type can be divided into the following groups—

- (i) Frizzly—Waves provided with very strong curvatures.
- (ii) Loose Frizzles—These are flat spirals and circular.
- (iii) Thick Frizzles—More or less like the above form but these are thickly set.

(iv) Filfil—The hairs are heavily rolled popularly known as peppercorn hair.

## (3) Hair Texture

As regards texture the hairs can be divided into three groups e. g. (a) Coarse, (b) Medium, (c) Fine. In finding out texture the hairs of the subject should be examined by rubbing these with the help of the fingers. In order to get a correct result about the hair texture, the microscopic study is required.

## (4) Hair Quantity

The Quantity of hair can be classed like the following—

- (a) Scanty (b) Medium (c) Thick (d) Very thick
- (e) Rich.

This can be determined by visual observations.



### (5) Hair Whorl

The whorl of hair on the occiput is also an important somatological feature. Generally a man possesses one whorl but it is seen that there are persons who possess more than one whorls on the occiput. The whorls of the hair are of two types:—

(a) Clockwise and (b) anti-clockwise.

### (6) Hair Limit

The limit of hair on the frontal region is also another attractive somatological characteristic. This character is absent among those persons whose frontal regions are bald. This characteristic can be divided into two types—(a) U form, in this case the hair on the frontal part is displayed in the form of the English letter 'U'; and (b) M form, when the hair in the said region is seen in the form of 'M'. The former type of hair limit is seen mostly among the females, while the latter is the characteristic of the males.

The colour, quantity and characters of the moustache, beard and body hair can be explained by consulting the above characteristics.

### Eye Brows

Observe the following as regards eyebrows:—

- (a) Thickness—Thick, medium, fine.
- (b) Concurrencey.
- (c) Extension.

## SKIN COLOUR

It is very difficult to determine the exact skin-colour of a man as we do not find any standardized skin-colour chart with which the sample can be compared. Various charts to help in studying the skin colour have been prepared by various authorities, e.g. Broca's Colour Chart, von Luschan's Colour Chart. The former contains 34 photolithographed square paper pieces, while the latter is provided with 36 glass rectangles of various colours. The Electro-photometer is a new

venture in this field. According to Prof. Hooton the following terms may be used at the time of determination of skin-colour of a given subject—red white, pale white, ruddy, olive, light yellow-brown, light brown, medium yellow-brown, medium red-brown, copper, dark-brown and black. The skin-colour can only be determined by regular practice. While examining the skin colour of the subject, both the exposed and unexposed parts should be taken into account. It should be examined in a good lighted place and not in direct sun light.

## EYE

The eye has taken a most important role in racial discrimination. The eye should be studied according to the following features—eye-slits, eye fold and eye colour.

### Eye Colour

The colour of the eye can be determined by the help of the chart of Martin-Schultz. It is provided with twenty glass eyes arranged, in a metal case, in two rows. In determining the eye-colour these terms have been used by Hooton—black, dark-brown, light-brown, blue-brown, gray-brown green-brown, blue and gray.

### Sclera

The colour of the sclera can be described by the following terms—clear ; speckled ; yellow.

### Iris

In examining the iris it should be observed by means of a lens and can be described by the following terms—homogeneous, rayed, zoned, speckled, diffuse.

## Forehead

Observe the forehead like the following—

- (a) Height—Low, medium, high.
- (b) Breadth—Narrow, medium, broad.
- (c) Slope—Absent, slight, medium, pronounced.

**Supraorbital Ridgès**

Observe the supraorbital ridges on the following points—

- (a) Size—Perceptible, medium, massive.
- (b) Form—Medium, continuous.

**Nose**

Study the nose according to the following features—

- (a) Nasal Depression—Absent, shallow, medium, deep narrow.
- (b) Nasal Bridge—Straight, wavy.
- (c) Nasal septum—Straight, concave, convex. It may be inclined upwards or downwards.
- (d) Nasal wings—Compressed, medium, flaring.

**Malar**

Malar prominence—Absent, slight, medium, pronounced, bulky.

**Lips**

- (a) Lip form—Thick, medium, thin.
- (b) Lip eversion—None, slight, prominent.

**Chin**

- (a) Chin prominence—Sub-medium, medium, pronounced.
- (b) Chin form—Ordinary, square, pointed.

**Prognathism**

- (a) Alveolar—None, medium, above-medium, pronounced.
- (b) Facial—None, medium, above-medium, pronounced.

**Ear**

- (a) Lobes—Attached, free, notched, divided.

**Neck**

- (a) Size—Slender, medium, thick
- (b) Length—short, medium, long.

**Body and limbs**

- (a) General state—Slender, medium, sturdy, plump, obese.

### Breasts

The shape and size of the breasts, character of the nipples should be taken into consideration regarding the women subjects especially those who have got no children. Various descriptive terms relating to these observations have been noted below.

- (a) Shape—Conical, intermediate, hemispherical
- (b) Size—Small, medium, large
- (c) Nipples—Small, moderate, large.

### Hands and feet

The hands differ in stoutness which may be slim, medium or heavy. The relative length of the fingers and the digital anomalies should also be recorded.

The arch of the feet may be high, medium or flat. The prominence of the heels, the relative length of the toes and their position and peculiarities should be noted.

## MEASUREMENTS ON THE SKULL

### CRANIOMETRY

The skull is the most important and interesting part of the skeleton. It has attracted the attention of the scientists and various research works have been done on the same. The system of measuring the skeletal parts differs in so many ways from that of the living human being. The results of the measurements of the former is more accurate as it is not disturbed by the skin, muscles, hairs, etc. that one feels in the case of somatometry. The skull can be moved in any direction and the measurer can take any type of measurement at any time according to his will. It can be handled easily and is always at the disposal on the measurer.

The measurements and the observations on the human cranium date back to the beginning of the 19th Century. The

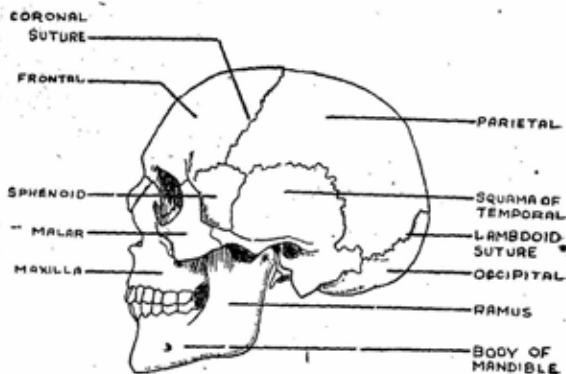


Fig. P. 9. The Skull and its different parts.

pioneers in this line were Samuel G. Morton of Philadelphia, Anders Retzius of Sweden and Paul Broca of France. Credit for establishing the subject of craniology in a proper place goes to

the scientists like Topinard, Turner, Torok, Schmidt and Martin. Then various other scientists of the different countries took up the work and made more improvement in the line.

### CRANIAL LANDMARKS

Before going to measure the various parts on the skull the following landmarks should be studied carefully.

#### ON BRAIN-CASE

1) Vertex—It is the highest point on the vault of the cranium.

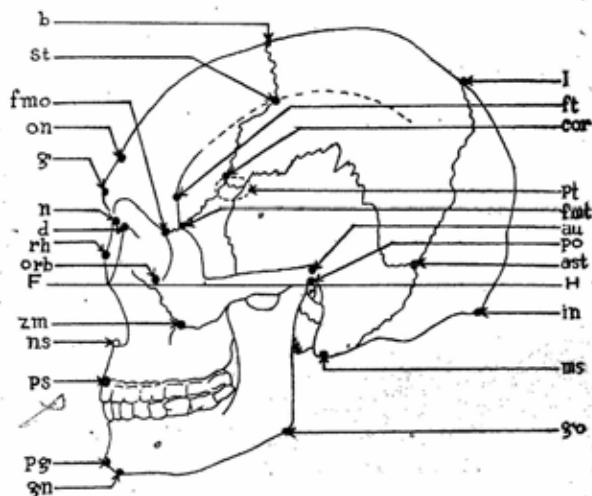


Fig. P. 10, Different Landmarks on the skull (side view)

(ast), asterion ; (au), auriculare ; (b), bregma ; (cor) coronale ; (d), dacryon ; (fmo) frontomalar orbitale ; (fnt), frontomalar temporale ; (ft), frontotemporale ; (g) glabella ; (go), gonion ; (gn), gnathion ; (I), Inion ; (l), lambda ; (ms) mastoidale ; (n), nasion ; (ns), naso-spinale ; (orb), orbitale ; (on), ophryon ; (pg), pogonion ; (ps), prosphenion ; (pt), pteryon ; (po), porion ; (rh), rhinion ; (st), stephanion ; (zm), zygomaxillare.

- 2) Glabella—It is most prominent point on the frontal bone between the two eye-brow ridges and just above the naso-frontal suture.
- 3) Bregma—A point on the meeting place of the coronal and sagittal sutures.
- 4) Opisthocranium—It is the most prominent point on the occiput in the mid-sagittal line.
- 5) Inion—The meeting point of the superior nuchal lines in the mid-sagittal plane.
- 6) Opisthion—It is the middle point on the posterior border of foramen magnum.
- 7) Basion—It is the middle point on the anterior border of the foramen magnum.
- 8) Pterion—It is a place on the side of the vault where the frontal, parietal, temporal, and sphenoid bones meet.
- 9) Lambda—It is a point on the meeting place of the sagittal suture and lambdoidal suture.
- 10) Porion—It is a middle point on the upper border of the auditory meatus.
- 11) Asterion—It is a point behind the mastoid process where the parietal, occipital and temporal bones meet.

### ON FACIAL REGION

- 1) Nasion—It is a point where the nasal suture meets the naso-frontal suture.
- 2) Naso-spinale—It is the deepest or lowest point on the inferior border of the nasal aperture in the mid-sagittal line.
- 3) Prosthion—It is a lowest point on the alveolar border of the maxilla between the middle incisors.

- 4) Dacryon—It is a point on the inner wall of the orbit where the frontal, lachrymal and maxillary bones meet.

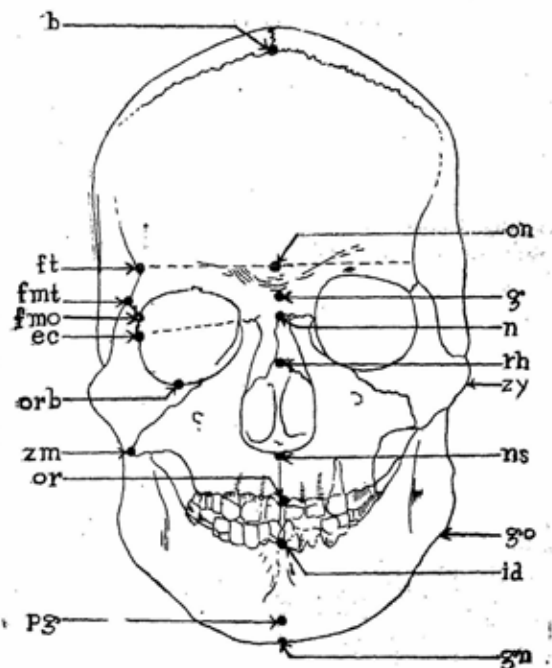


Fig. P. II, Different Landmarks on the skull ( Front view )

(b) bregma ; (ec), ectoconchion ; (fmo), frontomalare orbitale, (fmt), frontomalare temporale, (ft), frontotemporale ; (g), glabella ; (go), gonion ; (gn), gnathion ; (id) infradentale ; (on), ophryon ; (or) orale ; (orb), orbitale ; (pg), pogonion ; (n), nasion ; (ns), naso-spinale ; (rh) rhinion ; (zm), zygomaxillare ; (zy) zygion

- 5) Gnathion—It is a point on the lower border of the mandible in the median line (menton).



- 6) Gonion—It is a point on the external border of the mandible where the horizontal and ascending rami meet.

### MEASUREMENT TECHNIQUES

Select a well-lighted and less disturbed place where you will be able to carry on the measurements on the cranium carefully. The measurements on the skull, such as, length and breadth of the skull, nasal height, facial height, etc. should be taken by placing the skull on the pad in different manners. For certain height and angle measurements, the skull must be adjusted in a specially prepared instrument known as Craniophore. On this instrument, the skull can be placed on various planes. The

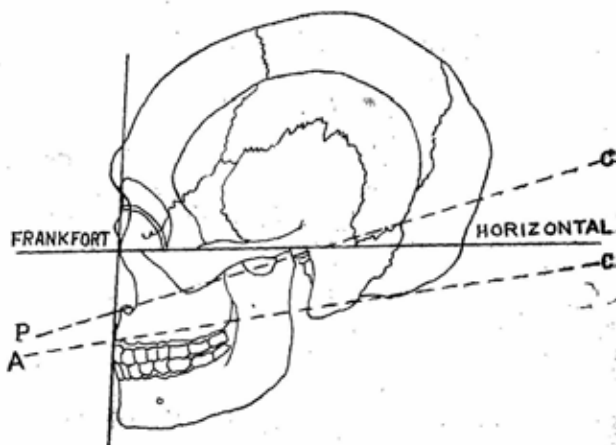


Fig. P. 12, The skull showing the Frankfort horizontal line.

A—C line indicates alveolo-condylar plane of Broca (1862) ; P—C line indicates Petrus Camber plane (1786).

planes of orientation of the skull are most important in craniometrical measurements. In order to correlate the outlines of

the various aspects of the skull and to compare the results obtained by the various classes of workers, it is necessary to suggest a particular plane of orientation. The most notable and acceptable plane of orientation is the *Frankfort horizontal* (F H Plane). In this plane, the lower margins of the orbits and the points on the upper margins of the auditory meatus are situated vertically above the centre. It secured the universal acceptance in a meeting at Frankfort, known as the *Frankfort Agreement of 1882*.

### Measurements

#### 1) Maximum Cranial Length

*Instrument*—Spreading Caliper.

*Landmarks*—Glabella to Opisthocranium.

*Method*—Keep the given skull on the pad on its right side.

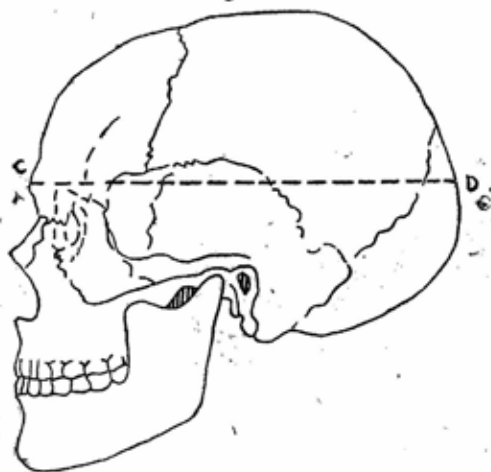


Fig. P. 13. Cranial Length, C and D indicate the measuring points.  
Hold the spreading caliper by means of your two hands in a

manner as previously directed. Touch the pointed left end of the caliper against the glabella and move the right end up and down on the occiput in the median line until you get the maximum length. Write down the maximum measurement from the adjoining scale.

*Precaution*—Do not go away from the mid-sagittal line while tracing out the opisthocranium point.

**2) Maximum Cranial Breadth**

*Instrument*—Spreading Caliper.

*Landmarks*—Euryon to Euryon.

*Method*—Place the skull in such a way that its basal region

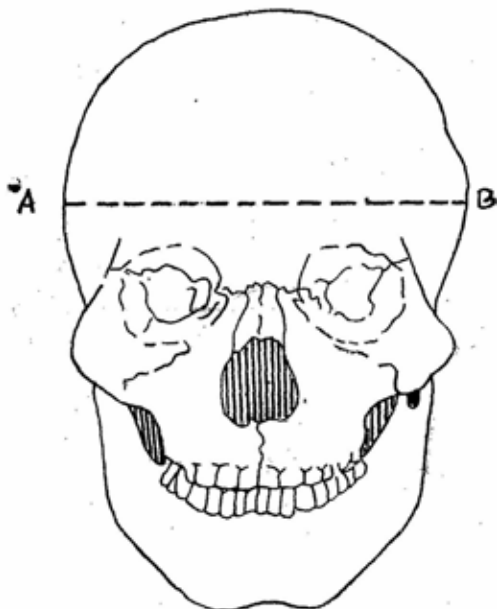


Fig. P. 14, Cranial Breadth—A and B indicate the measuring regions: rests on the pad. Hold the spreading caliper as directed and

move its two ends on the two parietal bones, perpendicular to the mid-sagittal line. Record the maximum measurement.

*Precaution*—Care should be taken to see that the ends of the caliper remain in the horizontal plane.

### 3) Maximum Bi-Zygomatic Breadth

*Instrument*—Spreading Caliper.

*Landmarks*—The external surface of the zygomatic arches.

*Method*—Place the skull in such a way that its base rests on the pad and its facial region at your side. Hold the instrument properly and apply its two ends on the zygomatic arches of the two sides. Record the measurement where you get the maximum.

*Precaution*—Take care in finding out the proper points of measurements by trial. Keep the two ends of the caliper horizontal.

### 4) Minimum Frontal Diameter

*Instrument*—Spreading Caliper.

*Method*—Place the skull in a manner similar to that of the previous measurement. Hold the instrument and apply its two ends on the temporal crest of the temporal bone. Move the ends of the caliper on the temporal crest until you get the minimum measurement.

*Precaution*—Take care about the horizontal position of the ends of the caliper.

### 5) Basion-Bregma Height

*Instrument*—Spreading Caliper.

*Landmarks*—Basion to Bregma.

*Method*—Place the skull so that its right side rests on the pad. Hold the caliper as directed and apply its left end on basion and right end on bregma. Note down the measurement from the scale.

### 6) Total Facial Length

*Instrument*—Sliding Caliper.

*Landmarks*—Nasion to Menton.

*Method*—Place the skull on the pad so that its occipital region rests on it. Hold the instrument and apply its upper pointed crossbar on the nasion and the left crossbar on the menton point. Take down the measurement from the adjoining scale.

*Precaution*—Adjust the mandible with the skull carefully so that the two sets of teeth are pressed against each other as in natural condition.

### 7) Upper Facial Height

*Instrument*—Sliding Caliper.

*Landmarks*—Nasion to Prosthion.

*Method*—Place the skull in a manner similar to the above measurement and apply the fixed end of the crossbar of the caliper against nasion point. Then, by sliding the moveable crossbar adjust its sharp end against prosthion point. Note down the measurement.

*Precaution*—Take care in finding out the prosthion point. Do not take this measurement in such a skull which lacks the incisors.

### 8) Basion-Nasion Length

*Instrument*—Spreading Caliper.

*Landmarks*—Basion to Nasion.

*Method*—Place the skull in the norma basalis position. Hold the caliper and adjust the end of its left arm on nasion point. Then by sliding the other arm apply its end-point against the basion point. Note down the measurement.

### 9) Basion-Prosthion Length

*Instrument*—Spreading Caliper.

*Landmarks*—Basion to Prosthion.

*Method*—Place the skull on the Norma basalis position and apply the left end-point of the instrument on prosthion and the right on basion points. Note down the measurement.

**10) Nasal Height**

*Instrument*—Sliding Caliper.

*Landmarks*—Nasion to Sub-nasal.

*Method*—Place the skull in such a way so that its basal region rests on the pad. Apply the fixed pointed crossbar on nasion and take two measurements by adjusting the other crossbar on the two lower borders of the nasal aperture on each side of the spine. Find out the mean of the two measurements.

**11) Nasal Breadth**

*Instrument*—Sliding Caliper.

*Method*—Hold the sliding caliper by your right hand and take the maximum measurement by placing the two ends of the crossbars on the two farthest points of the nasal aperture. This measurement will be perpendicular to the height.

**12) Height of Orbit**

*Instrument*—Sliding Caliper.

*Method*—Hold the sliding caliper and take the maximum measurement by placing the crossbar ends on the upper and lower borders in the middle of the orbit. Take the measurement on both the orbits and note down.

**13) Breadth of the Orbit**

*Instrument*—Sliding Caliper.

*Method*—Adjust the fixed crossbar end of the caliper on dacryon and the other end on the middle of the external border. Take this measurement on both the orbits and note down.

**14) Inter-Orbital Breadth**

*Instrument*—Sliding Caliper.

*Landmarks*—Dacryon to Dacryon.

*Method*—Place the skull on its base and adjust the two ends of the two crossbars of the caliper on two dacryon points and note down the measurement.

**15) Bi-orbital Breadth**

*Instrument*—Sliding Caliper.

*Method*—Adjust the two pointed ends of the two crossbars of the caliper against the middle of the two external borders of the orbits and note down the measurement.

**16) Length of the Palate**

*Instrument*—Sliding Caliper.

*Method*—Place the skull in such a way so that its norma-verticalis rests on the pad. Place the fixed end of the crossbar of the caliper on the prosthion point. Then place the other crossbar on the point tangent to the posterior edges of the alveolar borders.

**17) Breadth of the Palate**

*Instrument*—Sliding Caliper.

*Method*—Place the skull as you have done in the above case and take the maximum breadth measurement on the outside of the alveolar borders. Adjust the ends of the two crossbars on the outside of the said border at the level of the second molars.

**18) Mean diameter of Foramen magnum**

*Instrument*—Sliding caliper.

*Method*—Place the skull in norma basalis position and take the mean of maximum lengths, by placing two pointed ends of the caliper on basion and opisthion points, and maximum transverse diameter of the foramen magnum.

**19) Nasion-Opisthion arc**

*Instrument*—Steel tape.

*Method*—Place the skull on its right side on the skull pad. Apply the zero point of the steel tape against the nasion by your left hand. Then by your right hand extend the tape along the sagittal suture, occiput and place it at opisthion. Read the distance between these two points from the scale. Care should be taken to see that the tape always remains on the median line.

## 20) Transverse arc

*Instrument*—Steel tape.

*Method*—Place the skull in norma basalis position. Apply the zero point of the tape on the right porion which will be kept in position by your left hand. Then by your right hand extend the tape along the bregma and apply it against the left porion. Record the distance from the scale.

## 21) Maximum Circumference of the Skull

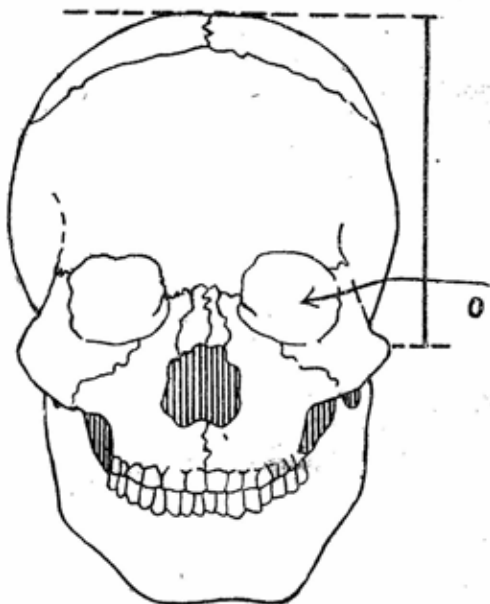
*Instrument*—Steel Tape.

Fig. P. 15. Auricular height of the Skull (Front view).

O indicates the orbit.

*Method*—Place the skull on the pad so that its basal region



rests on it. Then by drawing the tape put its zero point on right temporal crest just above the brow-ridges. Keep it in position by means of your left hand. Then by your right hand pass the tape around most projecting points on the occiput, the left side and across left temporal crest. Then ultimately touch the other end of the tape with the zero point on the right temporal crest. Read the measurement at the overlapping point and record it.

*Precaution*—Care should be taken to see that the tape passes above the brow-ridges. It also should rest on the most protuberant point of the occiput.

## 22) Auricular Height of the Skull

*Instrument*—Craniophore and Sliding Caliper (large).

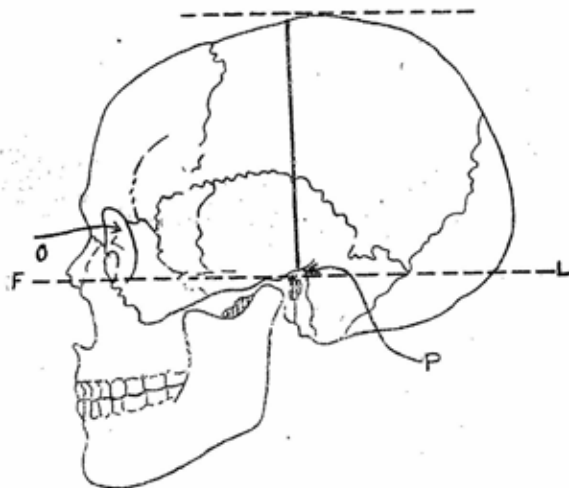


Fig. P. 16. Auricular height of the Skull (side view).

P indicates the porion point.

*Method*—Adjust the skull in eye-ear plane on the cranio-

phore and measure the height from porion to vertex and record it.

### 23) Bi-condylar Breadth

*Instrument*—Sliding Caliper.

*Method*—Put the two pointed ends of the crossbars of the caliper on the two external points of mandibular condyles and measure the breadth between the two from the scale.

### 24) Height of the Symphysis

*Instrument*—Sliding Caliper.

*Method*—Hold the mandible in such a way so that its anterior portion faces you, and adjust the pointed ends of the crossbars—one at the Gnathion and the other at the infra-dentale i.e. the point on the alveolar border between middle incisor teeth of the mandible.

### 25) Bi-gonial Diameter

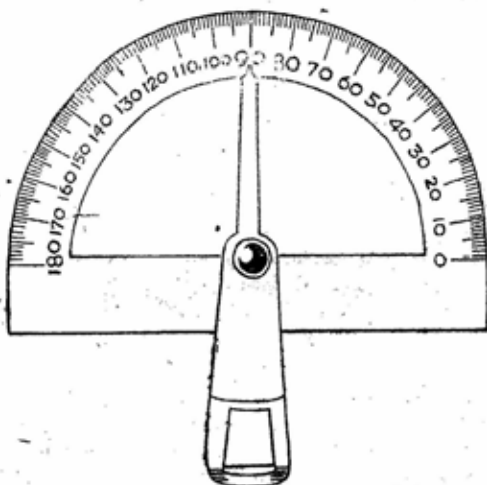


Fig. P. 17. Goniometer. used in measuring cranial and facial angles.

*Instrument*—Sliding Caliper.

*Method*—Hold the mandible in such a way so that its posterior portion faces you, and apply the two pointed ends of the caliper against two goina points and measure the distance from the adjoining scale.

## 26) Angle of the Lower Jaw

*Instrument*—Mandibular Goniometer.

*Method*—The angle of the lower jaw is to be taken by a specially designed instrument known as mandibular goniometer. Place the mandible on the goniometer in natural position and slowly raise the inclined plane until it touches, in a tangent position, to the posterior edges of both ascending rami. Read the angle from the side.

*Precaution*—Do not apply force to the posterior border of the mandible while raising the inclined plane of the instrument.

## CRANIOMETRICAL INDICES

The various indices used in craniometry and their classifications are given below.

### 1. Length-Breadth Index =

$$\frac{\text{Maximum skull breadth}}{\text{Maximum skull length}} \times 100$$

Hyperdolichocranial— 68.4

Dolichocranial — 68.5 – 73.9

Mesocranial — 74.0 – 78.9

Brachycranial — 79.0 – 83.4

Hyperbrachycranial—83.5 +

### 2. Length-Height Index =

$$\frac{\text{Auricular height of the skull} \times 100}{\text{Maximum skull length}}$$

Chamaecrany — 69.9

Orthocrany — 70.0 – 74.9

Hypsocrany — 75.0 +

## 3. Breadth-Height Index =

$$\frac{\text{Auricular height of the skull}}{\text{Maximum skull breadth}} \times 100$$

Tapeinocrany— -91.9

Metriocrany —92.0—97.9

Acrocrany —98.0+

## 4. Facial Index (total) =

$$\frac{\text{Menton-Nasion height}}{\text{Max. Bizygomatic breadth}} \times 100$$

Hypereuryprosopy— -79.9

Euryprosopy—80.0—84.9

Mesoprosopy—85.0—89.9

Leptoprosopy—90.0—94.9

Hyperleptoprosopy—95.0+

## 5. Facial Index (upper) =

$$\frac{\text{Naso-Alveolar diameter} \times 100}{\text{Bizygomatic diameter.}}$$

Hypereuryeny— -44.9

Euryeny —45.0—49.9

Meseny —50.0—54.9

Hyperlepteny—60.0+

## 6. Nasal Index =

$$\frac{\text{Max. nasal breadth}}{\text{Max. nasal height}} \times 100$$

Leptorrhiny — -46.9

Mesorrhiny —47.0—50.9

Chamaerhiny —51.0—57.9

Hyperchamaerhiny—58.0+

## 7. Orbital Index =

$$\frac{\text{Mean height of the orbits}}{\text{Mean breadth of the orbits}} \times 100$$

Chamaeconchy— -82.9

Mesoconchy —83.0—88.9

Hypsiconchy —89.0+

## 8. Upper alveolar arch Index =

$$\frac{\text{Breadth of the alveolar border} \times 100}{\text{Length of the alveolar arch}}$$

Dolichurany— -109.9

Mesurany —110.0—115.0

Brachyurany—115.0+

## OBSERVATIONS

Visual observations give the observer a well-rounded impression of the specimen. But the method is full of uncertainties and utmost difficulties. The various observations on the skulls should be made after thorough training and careful practice in this line. The following terms and standards are used, by Hrdlicka in craniological observations.

## The Vault

- (a) *Form* (in norma verticalis)—Ovoid, pentagonal, elliptical, round.
- (b) *Supraorbital ridges*—Trace, slight, moderate, pronounced.
- (c) *Forehead*—
  - Height—Low, medium, high.
  - Breadth—Narrow, medium, broad.
  - Slope—Absent, slight, medium, pronounced.
- (d) *Sagittal region*—Oval, moderately or markedly elevated.
- (e) *Temporo-parietal region*—
  - Parietal eminences—Indistinct, medium, prominent.
  - Temporal region—Flat, medium, bulging.
- (f) *External occipital protuberance*—Absent, moderate, pronounced, double.
- (g) *Mastoid*—Small, moderate, medium, large, excessive.
- (h) *Occipital crests*—Absent, slight, moderate, well-developed, pronounced.
- (i) *Sutures*—
  - Serration—none, slight, medium, complex.

## The face

- (a) *Prognathism*—Facial—none, slight, medium, above medium, pronounced.  
Alveolar—None, slight, medium, above medium, pronounced.
- (b) *Orbits*—Shape—round, rectangular.  
Borders—sharp, dull.
- (c) *Malars*—Size—Sub-medium, medium, large.  
Protrusion—slight, sub-medium, medium, marked.
- (d) *Nasal bones*—Narrow, medium, broad.
- (e) *Nasal spine*—Absent, diminutive, medium, pronounced.
- (f) *Lower borders of the nasal aperture*—Sharp, dull.
- (g) *Palate*—Form—elliptic, ovoid, U-shaped, near circular, horseshoe-shaped.  
Depth—shallow, high.

## Lower jaw

- (a) *Size*—Small, medium, large, massive.
- (b) *Chin*—Form—Pointed, rounded, square, ordinary.  
Prominence—Submedium, medium, pronounced.
- (c) *Rami*—Narrow, medium, broad.

## Teeth

- (d) *Dentition*—The eruption of teeth should be noted. Milk and permanent teeth should be carefully distinguished.
- (e) *Size*—Small, medium, large.
- (f) *Wear*—None, slight, moderate, marked, excessive.

## Techniques of the determination of Age from the Skull

The determination of age from the skulls is of greatest value in the medico-legal cases. The correct estimation of age by examining the various features on the skull is also an important

matter in studying the subject of Anthropology. The important criteria for age determination from the skull is given below.

- (1) The eruption of milk teeth.
- (2) The eruption of permanent teeth.
- (3) The condition of the teeth.
- (4) The sutural closers.

### Eruption of Teeth

The eruption of milk and permanent teeth is of much importance in estimating the age of an individual after death. But this is limited up to a certain age. No reliable Indian data is available regarding the teeth eruption time, as no large-scale survey has yet been taken up in this country about the said topic. The present tables have been prepared on the basis of the study that have been made by Hrdlicka in European countries.

#### (1) Age of Milk Teeth Eruption

Teeth . . . . . Ages of Eruption in months.

	Upper jaw	Lower jaw
Median Incisor	8—11	4—8
Lateral Incisor	8—11	12—15
1st Molar	9—21	12—21
Canine	16—24	16—25
2nd Molar	20—36	20—36

#### (2) Age of Permanent Teeth Eruption

Teeth . . . . . Ages of Eruption in years.

	Upper jaw	Lower jaw
1st Molar	5—8	4—7
Lateral Incisor	6—10	6—10
Median Incisor	7—8	7—8
Anterior Premolar	7—14	8—15
Canine	9—16	8—14
Posterior Premolar	9—15	9—15
2nd Molar	10—17	10—17
3rd Molar	17—30	15—30

### (3) Condition of the Teeth

It is very difficult to estimate the age of a given skull by examining the wear of the teeth which depends upon their hardness, the nature of diet and the length of time that the teeth are in service. In those civilized persons who live on soft cooked and soft type of food, the wear of the teeth is minimum. A group of persons may exhibit the wear of the teeth due to the lack of required vitamin in their bodies. Therefore, we see that the wear of teeth depends on certain factors and it is troublesome for correct estimation of age by this method. Among the primitive people, whose dietetic pattern has been less affected by the modern civilization, the wear of the teeth helps us to some extent in the determination of age. Hrdlicka has studied the Eskimos and the American Indians regarding the condition of the teeth and the age determination. His results have been summarized below:—

Description of the condition of teeth.	Approximate ages.
(a) Wear on the tips of the cusps and edges	When the individual attains puberty.
(b) Cusps of the molar worn off	26-33 years.
(c) Enamel of the grinding surfaces of the teeth worn off	35-50 years.
(d) Crowns worn off greatly	65 years and above.

### (4) Sutural closers

The closing of the cranial sutures in the immature skulls is the most important criteria for the estimation of age. Each cranial suture possesses two aspects—*endocranial* and *ectocranial*. The former is seen on the inner side of the skulls while the latter is visible only from the outside. The closure of suture of both the sides begins more or less at the same time, but in studying the sutural closers the endocranial aspect is most reliable. It is very difficult to examine endocranial suture until and unless the skull is broken. In these cases we shall have to depend on the ectocranial sutures only. A table



regarding the times of important types of sutural closers is given below.

### Times of Sutural Closers

Description of the various sutures.	Age in years.
(1) Central part of sagittal suture closes at	22—29
(2) Coronal part of sagittal suture closes at	35
(3) Lambdoidal part of sagittal suture closes at	35
(4) Central part of coronal suture closes at	38
(5) Temporal part of coronal suture closes at	41
(6) Central part of lambdoidal suture closes at	42
(7) Temporal part of lambdoidal suture closes at	49
(8) Parieto-mastoidal suture closes at	51
(9) Spheno-parietal suture closes at	64
(10) Squamous suture closes at	81

## MEASUREMENTS ON THE BONES

### OSTEOMETRY

Measurements on the skeletal parts are recent in comparison to those on the skulls and living human beings. Studies on the various parts of the skeletal remains were, first of all, confined to the anatomists. The proper anthropometrical study of the bones was developed by Broca and his students in Paris. From that time various types of works are being done by the scientists of different nationalities. The discoveries of the skeletal parts of early men from the different layers of the earth have stimulated various research works in this line. But, on the whole, osteometrical study does not yet produce any satisfactory result; and more works are still to be done to get a clear scientific knowledge in this direction.

In osteometrical measurements a few instruments, such as, osteometric board, sliding calipers, osteophores, steel tape, horizontal needle etc. are essential.

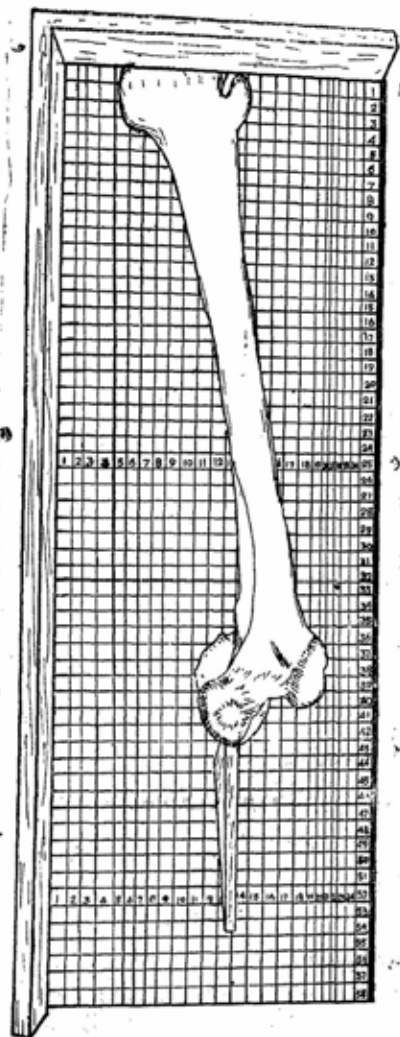


Fig. P. 18. Osteometric Board. A femur has been placed on it for certain length measurements.

### Measurement techniques

The measurements of the long bones should be taken in the following ways.

#### HUMERUS

##### 1. Maximum length

This measurement should be taken on the osteometric board. Apply the head of the humerus against the vertical wall of the board and keep it by means of your left hand. Then by your right hand apply the block of the board horizontally to the distal end of the bone. Record the maximum length from the scale of the board.

##### 2. Maximum diameter of the shaft

This measurement is to be taken on the shaft which should be found out with the help of the osteometric board. Mark the point with a pencil. Then lay the stem of the caliper on the antero-medial part and apply the branches of the instrument to the bone. Read the maximum measurement.

##### 3. Minimum diameter of the shaft

This is also to be measured with the help of former instrument. This measurement should be taken by applying the fixed branch of the sliding caliper to the antero-medial surface of the bone just at its middle portion. The minimum measurement should then be noted down.

#### RADIUS AND ULNA

The measurements of these two bones should be taken in the way similar to those of the humerus.

#### FEMUR

##### 1. Maximum length

This measurement is to be taken on the osteometric board. The greatest length from the internal condyle to the extreme point of the head is to be taken from the scale of the board.

## 2. Bicondylar length

In this measurement the condyles of the femur should be applied against the vertical wall of the osteometric board. Then the movable square is to be applied to the head of the femur tangentially. The measurement should be read from the scale.

## 3. Maximum diameter of the head.

This measurement is to be taken by the sliding caliper.

## 4. Middle shaft diameter, antero-posterior.

First of all, determine the middle point of the shaft and mark it by a pencil. Then take maximum diameter by the sliding caliper.

## 5. Middleshaft diameter, lateral

This measurement is to be taken at the same point as the former but it should be taken transversely i.e, perpendicular to the former measuring plane.

## 6. Sub-trochanteric diameter, antero-posterior

It is the sagittal diameter of the shaft below the lesser trochanter and should be taken by the sliding caliper.

## 7. Sub-trochanteric diameter, lateral

It is the transverse diameter at the same point as the former.



Fig. P. 19 A long bone is placed on the osteometric board for measurement

### 8. Circumference of the shaft at middle

It is taken by means of the steel tape just at the middle of the shaft marked beforehand. This gives the robustness of the shaft.

## TIBIA

### (1) Maximum length

The maximum length of the tibia is to be taken on the osteometric board. First of all place the tibia on the board in such a way that the malleolus touches the vertical wall and long axis of the bone remains parallel with long axis of the board. Then carefully adjust the square against the anterior edge of the lateral condyle external to the tibial spine. Read the measurement.

### (2) Middle diameter, antero-posterior

Find out the middle point on the tibial crest and mark it by pencil. Then measure the antero-posterior diameter by means of the sliding caliper.

### (3) Middle diameter, lateral

This measurement should be taken at the same point as the former. But the measurement will be perpendicular to that of the former. The tibial crest should be placed against graduated bar of caliper.

## FIBULA

### (1) Maximum length

The total length should be taken on the Osteometric board.

## SCAPULA

### (1) Morphological breadth

The distance between the highest point of the superior angle and the lowest point of the inferior angle. This is to be measured by the sliding caliper.

### (2) Morphological length

This should be measured by the spreading caliper. The two

landmarks of the measurement are the middle point of the glenoid fossa and the point of the vertebral border midway between the two ridges terminating the spine. The mid-point of the juncture of the spine with the border should be marked.

(3) Glenoid point height

The distance between the inferior angle and the center of the fossa situated near the middle of the glenoid cavity. This is to be measured by sliding caliper.

(4) Glenoid point breadth

The distance between the inferior angle and the point on the outer border of the glenoid cavity.

### STERNUM

(1) Total length

This should be measured on the osteometric board. The large sliding caliper may also be used in this case.

(2) Greatest breadth and thickness of the body

These measurements are to be taken by the sliding caliper. The latter measurement should be taken between the faces of the ribs.

### CLAVICLE

(1) Maximum length

This measurement is to be taken on the osteometric board, the sliding caliper may also be engaged for this.

### PELVIS

(1) Pelvic height

The distance from the highest point of iliac crest to the deepest point of ischial tuberosity is to be taken by the large sliding caliper. It is better to measure both the pelvic bones separately and find out the mean.

(2) Greatest pelvic breadth

It is the maximum diameter outside of iliac crests.

**(3) Sagittal diameter of pelvic inlet**

This measurement is to be taken by the sliding caliper. It should be measured from the middle point of edge of sacral promontory to middle of posterior ridge of upper symphyseal border.

**(4) Transverse diameter of pelvic inlet**

This is also to be taken by sliding caliper. It is the maximum transverse diameter of the pelvic inlet between *Liniae arcuatae*.

**SACRUM****(1) Maximum height**

This measurement can be taken by the sliding caliper. The distance between the middle of promontory and middle of the antero-inferior border of the fifth sacral vertebra will give the maximum height of the sacrum.

**(2) Maximum breadth**

By the sliding caliper the greatest breadth of sacrum is to be measured at the level of anterior projection of the auricular surface.

**PATELLA****(1) Maximum height and breadth**

Place the bone between the two cross bars of the sliding caliper in side to side position. Then by moving the bone try to find out the maximum measurement.

**(2) Maximum thickness**

Apply the fixed crossbar of the sliding caliper against the anterior surface of the bone, and then by sliding the movable bar place it on the posterior face over the thickest parts.

**OBSERVATIONS**

The following observations are to be made in respect of the various skeletal parts.

**Humerus**

- (a) Shape of shaft—Prismatic, lateral prismatic, quadrilateral, plano-convex, intermediary.
- (b) Supra-condylar process—None, rough, trace.
- (c) Ridge—Slight, medium, pronounced.

**Radius**

- (a) Shape—Prismatic, flexor surface concave, external surface convex, etc.

**Ulna**

- (a) Shape—Prismatic, flexor surface concave, quadrilateral.

**Femur**

- (a) Shape—Oval, elliptical, prismatic, cylindrical, quadrilateral.
- (b) Crista hypotrochanterica—absent, medium, pronounced, very pronounced.
- (c) Fossa hypotrochanterica—absent, medium, pronounced very pronounced.
- (d) Third trochanter—absent, medium, pronounced, very pronounced.
- (e) Linea aspera—absent, medium, pronounced.

**Tibia**

- (a) Shape—Prismatic, lateral prismatic, external surface concave, posterior surface divided into two, posterior surface convex, internal border indistinct, plano-convex.
- (b) Retroversion of head—Absent, medium, pronounced.
- (c) Lateral condyle—convex, concave.

**Fibula**

- Shape—ordinary quadrilateral, approaching prismatic, lateral prismatic, medial surface fluted, lateral surface differentiated into two surfaces, lateral surface fluted, both medial and lateral surfaces fluted.



**Scapula**

- (a) Vertebral border—Straight, concave, convex.
- (b) Shape of acromion process—Sickle, triangular, quadrangular, intermediate.
- (c) Scapula notch—none, slight, medium, deep, foramen.

**Clavicle**

- (a) Strength—Slender, medium, strong, massive.
- (b) Curvature—slight, medium, pronounced.

**Pelvis**

- (a) Depth and breadth of ischiatic notch—small, medium deep.
- (b) Sub-pubic angle—small, medium, large.
- (c) Ischia—parallel, converging, diverging.

**Sacrum**

- (a) Curvature—slight, moderate, pronounced.

**Patella**

- (a) Vastus notch—none, moderate, slight.

## GLOSSARY

### ANTHROPOLOGY

The scientific study of man and his works. It has a greater scope. The word anthropology is first met in an anonymous book written in English where the subject has been divided into psychology and anatomy. The anthropologists study man from the different angles. They analyse the physical features of man, his origin and development through the ages. The differences in physical characters, cultural features, social, political, religious and other affairs in the different human communities are also the subject-matter of their study.

### ANTHROPOLOGY, CULTURAL

The scientific study of the different behaviours of man. It studies man as a cultural being.

### ANTHROPOLOGY, PHYSICAL

The scientific study of the physical aspects of man. It includes human biology which deals with the origin of man and his development from the earliest time. The different varieties of man and their inter-relationship is also the subject-matter of this branch.

### ANTHROPOLOGY, SOCIAL

The scientific study of the social behaviour of man. It mainly concerns with the social system of the nonliterate communities.

### ANTHROPOMETRY

The branch of science which deals with the measurements of the human body by weight, proportions and size.

### ANTHROPOID

It includes such animals who possess characteristic of the primate sub-order. It embraces true-monkeys, apes and man. The evolution of anthropoid took place in the Tertiary period.

### ABBEVILLIAN

The name of a Lower Palaeolithic cultural phase. The type station is at Abbeville in France. The typical implements include the large hand-axes made on Core. Formerly Abbevillian was known by the name Chellean which came from the type station Chelles in France.

**ARCHAEOLOGY**

It is a branch of science which investigates the history of human societies with the help of the remains belonging to the earlier periods of their existence.

**ACHEULEAN**

The name of a Lower Palaeolithic cultural phase. The type station is at Saint-Acheuil in France. The implement, include the hand axes but these are smaller and better than those of the Abbevillian.

**AZOIC**

It points out to the earliest stage of the earth when there was no trace of life.

**ABORIGINE**

This term is used to denote the native of an area before the arrival of any other settlers.

**AURIGNACIAN**

The name of an Upper Palaeolithic cultural phase. It was marked by the Wurm recession and the Cro-Magnon man was associated with this cultural phase. This period is characterised by the improved techniques in making stone, bone and ivory tools, and the different kinds of artistic activities. It is named after the type-station Grotto de Aurignac.

**ANTIGEN**

A substance in the human blood which act in the differentiation of one person from the other.

**ANTIBODY**

When a certain chemical substance is introduced into an animal body, the tissues will react by producing a special reacting substance which is known as antibody.

**AGGLUTININ**

It is antibody stimulated by an antigen.

**AGGLUTINATION**

The red blood corpuscles clump together in the presence of agglutinin. This phenomenon is known as agglutination.

**AGGLUTINOGEN**

An antigen that causes agglutination if mixed with blood of other group.

**ALBINISM**

The absence of pigmentation on the skin, eyes and hair. It may be complete or partial. The complete loss of pigmentation is known as albinism.

**BIVALENT**

It is a pair of homologous chromosomes that unite during the first meiotic division of the cell.

**BLOOD**

The fluid and its constituent parts that circulate within the arteries, veins and capillaries. The fluid portion of the blood is known as plasma, on which there are suspended numerous cell-like bodies—the erythrocytes (red cells), leukocytes (white cells) and platelets (blood plates). Due to the multitude of the red cells the colour of the blood becomes red.

**CAUCASOID**

One of the major racial groups of man, centering around Mediterranean seas. The characteristic features of this group are white skin, long nose, straight or wavy hair of fine to medium texture. The colour of the eye ranges from light blue to dark brown.

**CELL**

The structural and functional unit of plants and animals. The cell is composed of different kinds of specialised parts. The nucleus is the controlling organ of the cells in which there are thread-like bodies—the chromosomes.

**CHROMOSOME**

These are thread-like bodies and present inside the nucleus of the cell. The chromosome carry genes through which the hereditary potentialities are transmitted.

**CROSS**

A mating between two individuals.

**CROSSING OVER**

The exchange of genes between the two homologous chromosomes at meiosis.

**CYTOPLASM**

All the contents of a cell except the nucleus.

**CRANIOMETRY**

The scientific measurements on the different parts of the skull.

**CRANIOPHORE**

An instrument which is used in holding the skull in any desired position for the purpose of measurements.

**CRANIUM**

The skull excluding the lower jaw and the bones of the face.

**CENTROMERE**

The structure found within the chromosome that attaches it during division of the cell with the spindle.

**CATARRHINI**

The animals who possess narrowly spaced and downwardly directed nostrils.

**CANNIBALISM**

Eating the human flesh as either a symbolic or regular food.

**DRAVIDIAN**

A linguistic family of Southern India. Before the appearance of Indian and Indo-European they were regarded as the leading groups. It is also spoken in central India, eastern Beluchistan and in northern Ceylon. Tamil, Telugu, Kurukh, Kui-Gondi and Brahui are the chief branches of this family.

**DIPLOID**

When the chromosomes are present in pairs, and the members of which are homologous. It is the characteristic feature of all the somatic cells.

**DIASTEMA**

A natural space that is found between the teeth.

**DEPIGMENTATION**

The loss of pigment from some organs of the individual.

**DERMATOGLYPHICS**

The study of the ridge patterns of the skin of fingers, palms, soles and toes in a scientific way.

**EVOLUTION**

The process by which the simple and homogenous forms gradually become complex and heterogeneous. In physical anthropology, the concept of evolution is used in tracing the development of *Homo sapiens*. Sometimes the cultural anthropologists also use the idea of evolution in understanding the development of different human institutions from simple to more complex.

**EMBRYO**

It is a stage in the process of development from the Zygote. The human organism in the process of development is known by the different names. The *ovular phase*—from the time of conception to the second week. The *embryonal phase*—from the end of the second week to the beginning of the eighth week. The *fetal phase*—from the beginning of the third month to birth.

**EMBRYOLOGY**

The science which deals with the different phases of development of the embryo.

**ENVIRONMENT**

The external conditions and influences that act upon an organism. The study of environment in understanding the human life is important as it exerts influence on the socio-economic life and physical features of man.

**EPICANTHIC FOLD**

It is a fold of the eye in which the skin over the upper eyelid is loose and it hangs over the free margin of the eyelid. Sometimes it is called as Mongoloid fold. Among the Neo-Asiatic Mongoloids the epicanthic fold is very common and well-developed.

**EPICANTHIC FOLD, EXTERNAL**

It is an eye-fold in which the skin hangs over the external canthus.

**EPICANTHIC FOLD, INTERNAL**

It is an eye-fold in which the skin hangs over the inner canthus.

**EPICANTHIC FOLD, MEDIAN**

In this case the skin hangs over the middle region of the upper eyelid.

**ETHNOS**

Generally applied to a population, linked by both nationality and race. These people generally possess a more or less distinctive assemblage of physical features which pass through a common heredity. This decision is, however, arbitrary.

**EUGENICS**

The branch of science which analyses the different hidden mechanism of heredity and genetics with a view to improve the quality of the human race. It was Galton who became very much interested in that matter and started work seriously as early as 1904.

**FERTILIZATION**

The union of ova and sperms.

**FOETUS**

The organism within the uterus. The human embryo from the beginning of the third months to birth.

**FOSSIL**

The object which has been preserved in the layers of the

earth. The fossils are the hard parts of animals or plants which have been infiltrated by mineral substances, present in the layers of the earth, and turned into stones.

## GAMETE

A mature germ cell. In male, it is called spermatozoon and in female, it is known by the term ovum.

## GENE

The minute globules that are present within the chromosome are regarded as the bearers of specific hereditary potentialities.

## GENETIC DRIFT

The phenomenon of non selective random distribution, fixation or extinction of genes in a group of people.

## GENE FREQUENCY METHOD

The determination of the degree to which the particular genes are present in a particular population. These method may be conducted when the manner of inheritance of the trait carried by these genes is understood.

## GENETICS

The branch of science which deals with the process of inheritance.

## GENOTYPIC

The genetic constitution of the individual. This is determined by the number, type and arrangement of the genes.

## GUNZ

The name of the second glacial period in Europe.

## GLACIATION

It is the phenomenon of covering of the greater parts of the earth by thick layers of ice. In the earlier period Europe witnessed four successive glaciations which had been named as Gunz, Mindel, Riss and Wurm after the four Swiss rivers. North America also had four important glacial periods which have been termed as Nebraskan, Kansan, Illinoian and Wisconsin.

## HAPLOID

Having a single set of unpaired chromosomes—the characteristic of the gametes.

## HEREDITY

The biological traits that are transmitted by the parents which determine the individual capacity for growth and development.

**HETERODONT**

The teeth that are specialised for different functions e.g. cutting, grinding, etc.

**HOLOCENE**

It is the term for most recent period. At this stage the various development of *Homo sapiens* has taken place.

**HOMODONT**

The teeth which are almost all alike.

**HOMOLOGOUS CHROMOSOME**

The chromosomes which are identical in nature, e.g. in number of genes in them. The sex chromosomes are the exceptions to this, they differ from one another regarding the form and the number of genes.

**HYBRID**

The offspring that has resulted due to the mating of two individuals of different ethnic origin.

**HOMINID**

It refers to the human being who have evolved in Pleistocene period and onward.

**HOMO**

It is the genus in which all the living varieties of man are included.

**INDEX**

Mathematically expressed relationship between the anatomical measurements.

**ISOLATION**

The arrangement in which the potential mating groups have been separated by social or ecological barriers for the prevention of mating.

**LANDMARKS**

In the body of man some specific points have been marked for the convenience of anthropometric measurements. These points are known as landmarks.

**LEPTORRHINE**

The nasal index which is less than 47 on the skull or less than 70 in the case of living.

**LEPTOPROSOPIC**

A narrow face. The total facial index varies between 90 and 99.4 on skull or more than 80 in the case of living.

**LINKAGE**

The behaviour of the genes to be transmitted together with



out recombining. Genes that are found on the same chromosome are said to be linked.

## MEIOSIS

The process of cell division in which the number of chromosomes are reduced by half. This process takes place in the germ cells, which, when unite to form the Zygote, restore the original number of chromosomes from the contribution of each parent.

## MELANIN

It is a kind of dark brown pigment, and on the frequency of which the various shades on skin, hair and eyes are responsible.

## MITOSIS

A type of cell division in which the chromosomes are distributed in equal number to the daughter cells. Before the distribution the chromosomes split up longitudinally.

## MINDEL

The name of the second glacial period in Europe.

## MOUSTERIAN

The name of cultural phase which speaks the way of life of the Neanderthal people who flourished during the Mid-Palaeolithic period.

## MONGOLIAN FOLD

Consult epicanthic fold.

## MUTATION

It is a spontaneous change in the genes of some individuals, which ultimately brings a change in the hereditary features of the individuals concerned. The effects of mutation are not generally detectable in any one generation. It was De Vries who suggested, first of all, the importance of mutation in the process of evolution.

## NEGRILLO

The pigmy group of Africa. They are shorter than all other pigmies and are found mostly in the Congo forests.

## NEGRITO

The pigmies of the Philippines. These people are prognathous; the colour of the skin ranges from reddish to dark brown and the nose is broad and flat. According to some, the Negritos are the most primitive human groups.

## NILOTIC NEGRO

A sub-race of the Negroid family who are found distributed in the Eastern Sudan and upper Nile areas.

**NEGROID**

One of the main ethnic groups of mankind. This group is characterized by the dark pigmented skin, black hair which range from a light curl to woolly or frizzly, low-bridged nose, very short to tall stature, narrow to medium broad face with everted lips.

**OLIGOCENE**

The sub-division of the Tertiary period when the early types of apes developed in Egypt and the evolution of the ancestors of the old world monkeys took place.

**ONTOGENY**

The growth and development of an organism.

**ORBIT**

The skull cavity within which the eye ball is placed.

**OSTEOLOGY**

The branch of science that deals with the structure of an organism.

**OSTEOMETRY**

The measurement and systematic analysis of the different bones of the skeleton.

**OOGENESIS**

The meiosis at the time of maturation of the female gamete.

**PENTADACTYLY**

The animals who possess five fingers and five toes.

**PHENOTYPE**

The actual characteristics of an organism. It includes anatomical, physiological and psychological features. It may simply be stated as the product of joint action of genotype and environment.

**PHYLOGYNY**

The history of development of an organism.

**PLATYCENEMIA**

The flattening of tibia—found in some human groups. Formerly it was believed to be a racial trait. But now it has been found that this characteristic is nothing but the result of muscular action.

**PLATYRRHINI**

The New World Monkeys—a member of the pithecolid sub-order. They are found in the tropical areas of America and provided with wide spaced nostrils.

**PLEISTOCENE**

In the geological history it is regarded as the last million years. It is also known as the age of glaciers. This period is characterised by the development of man.

**PLIOCENE**

It is the last phase of Tertiary epoch. The prehuman ancestors and the different types of ape developed in this period.

**P. T. C.**

Phenyl—thio—Carbamide. It is a white powder extensively used in determining taster or non-taster.

**PYGMY**

A racial group who are characterised by the stature below the average height of other groups. Generally the average height of the pygmies is four feet eight inches.

**QUATERNARY**

It is the geological period which is marked by the evolution of different kinds of present mammals.

**RACE**

A group of people whose common physical characters are transmitted through heredity and distinguishes it from other groups of people. The geneticist define the race as a population who differs from other population in the frequency of its genes. The term race has been utilized in a wrong way by almost all sections of people and which has been creating many disturbances in human society.

**RACIOLOGY**

The science that deals with the races of mankind.

**RAMAPITHECUS**

A Pliocene genus which have been discovered in India. These are regarded as the generalized human predecessors.

**RECESSIVE**

A gene carrying a characteristic feature whose appearance is blocked in the heterozygote.

**RISS**

The third glacial period that came in Europe.

**SIMIAN**

A family of catarrhini, which includes monkeys having ape-like features.

**SIMIDAE**

A family of the order Primate which includes manlike apes.

**SIVAPITHECUS**

An ape of the upper Miocene period discovered from the soil of India. It is regarded as a possible source from which man has been derived.

**SOMATOMETRY**

The measurement of the different parts of the living human body.

**SOMATOTYPE**

A classification of body builds based on types.

**STEATOPYGIA**

The buttocks that have become usually fatty. The Bushman and Hottentot women furnish this type.

**SYNOPSIS**

The phenomenon of the pairing of homologous chromosomes, on the eve of maturation division of the gametes.

**TELOPHASE**

The last stage of cell division when the nucleus is formed again around the chromosomes.

**TAURODONTISM**

In the molar teeth large pulp cavities are found which extend to the roots. Instead of being long and separate, the pulp cavities fuse into a kind of stump. The Neanderthal man exhibited this feature.

**TERTIARY**

The geological era belonging to the Cenozoic.

**TRIASSIC**

A period of the Mesozoic era. It is characterised by the development of mammals like marsupials and insectivores.

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(Note—The above chart is not exhaustive.)

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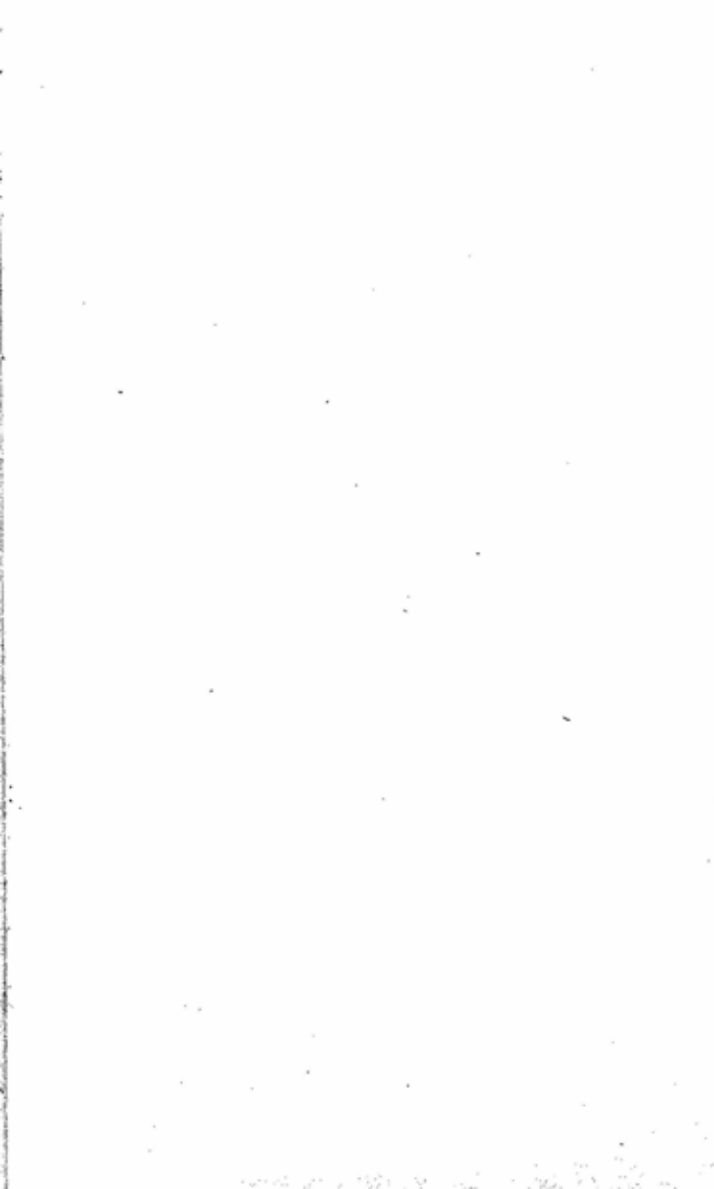
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